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QUARTERLY

Volume 11 JUNE, 1951 Number 2

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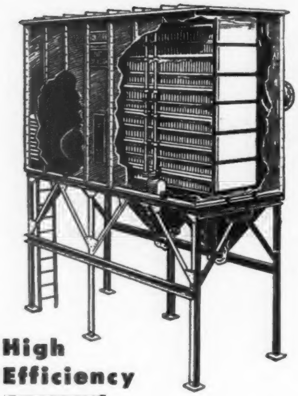
AMERICAN INDUSTRIAL HYGIENE ASSOCIATION QUARTERLY, published by the AMERICAN INDUSTRIAL HYGIENE ASSOCIATION in March, June, September, and December. HERBERT J. WEBER, Editor; HERBERT T. WALWORTH, Associate Editor; VINCENT J. CASTROP, Advertising Editor; WILLIAM T. McCORMICK, Circulation Editor; A. D. CLOUD, Publisher; DORIS FLOURNOY, Editorial Assistant. Publication, and Editorial Offices, 605 North Michigan Avenue, Chicago 11, Illinois. Subscription $2.00 per year in the United States; $2.50 per year in Canada; $3.00 per year in other countries. Single copies 75 cents. Copyright, 1951, The American Industrial Hygiene Association.

Entered as second class matter May 3, 1948, at the post office at Sheboygan, Wis., under the Act of March 3, 1879.



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AMERICAN
INDUSTRIAL HYGIENE
ASSOCIATION
QUARTERLY

Volume 11 | JUNE, 1951 | No. 2

THEODORE F. HATCH
Recipient of
The 1951 Cummings Memorial Award

THE AMERICAN INDUSTRIAL HYGIENE ASSOCIATION extended the accolade of the Cummings Memorial Award for 1951 on the occasion of its Twelfth Annual Meeting to THEODORE HATCH in recognition of his sustained contribution to the field of industrial hygiene. The Cummings Lecture presented there is published herein.

The Cummings Memorial Award carries the implication of a personal contribution of high order to the science and practice of industrial hygiene in any of its several functions. This Award is in commemoration of DONALD E. CUMMINGS, third President of the AMERICAN INDUSTRIAL HYGIENE ASSOCIATION, killed in an airplane crash in 1942 while on an occupational disease control project involving a material vital to the war effort.

DONALD CUMMINGS' own contribution to this field which has had the most lasting influence was the impact of his personality in the instigation of major industrial hygiene programs. His success in organizing well-conceived departments of industrial hygiene in manufacturing and mining industries was based on a broad working knowledge of the subject and a tremendous enthusiasm in imparting his ideas to others. The Cummings Award keeps before us the continuing needs and achievements along these very lines.

In the selection of the recipient of the Cummings Award for 1951, high standards had been set by those men who formerly received this Award: LEROY U. GARDNER in 1944, WILLIAM PARKS YANT in 1947, ALICE HAMILTON in 1948, and PHILIP DRINKER in 1950.

THEODORE HATCH entered the field of industrial hygiene as a member of the faculty of Harvard School of Public Health where he established an enviable reputation as a teacher and worker in the engineering phases of the subject. He served as chief industrial hygiene engineer, New York Department of Labor Division of Industrial Hygiene, and was with the University of Pennsylvania Department of Public Health prior to his position as Research Executive of the U.S. Armored Forces Medical Research Laboratories during the war with the rank of Lieutenant Colonel. He currently occupies two positions: Laboratory Director of the Industrial Hygiene Foundation of America where he also serves as Secretary of the Research Advisory Council; and Professor of Industrial Health Engineering, Department of Occupational Health, University of Pittsburgh Graduate School of Public Health.

A Past President of the American Industrial Hygiene Association, he has also served on the Board of Directors. He is co-author of "Industrial Dusts," and has published many papers on industrial hygiene subjects. His comprehension of the broader phases of the field and his vision of future developments are well evidenced by the Cummings Lecture in the following pages.

Objectives, Principles and Practices of Industrial Hygiene

Cummings Memorial Lecture
American Industrial Hygiene Association
1951

THEODORE HATCH
Graduate School of Public Health, University of Pittsburgh
Industrial Hygiene Foundation, Mellon Institute

INDUSTRIAL HYGIENE is a joint field of specialization, including both medical and non-medical specialists, who are primarily and equally concerned with those problems of health maintenance, productivity and well-being of industrial workers which are related to and affected by the conditions of work and by the stresses of the industrial environment. It is characterized by effective teamwork between the two groups and derives much of its strength from the demonstrated fact that the results from such teamwork are greater than the accomplishments of the two groups working separately and independently of each other. It recognizes differences in responsibilities and in nature of contributions. It maintains the identities of the several basic professions, but depends upon a special welding of skills for the most effective solution of industrial health problems, involving as they do both man and environment. A multiplicity of disciplines are brought to bear upon the manifold problems in industrial hygiene, including medicine, physiology, psychology, nursing, statistics and other mathematical skills, chemistry, physics and engineering. For convenience in this discussion, I shall classify these in two broad groups: medical science, concerned primarily with man and his social environment, and physical science, devoted to problems of the physical environment.

The rapid expansion of industrial hygiene activities over the past quarter century or more and its present firm position as a recognized field of specialization are in evidence of its practical usefulness. Industrial experience has shown repeatedly that, through the use of the procedures and practices of industrial hygiene, and especially the teamwork, the human problems of industry which come within its scope are solved more quickly and economically and with greater certainty of results than by alternative trial and error methods.

Contrary to the foregoing there is a tendency today to distinguish between industrial hygiene as a specialty of the physical sciences and the specialty of industrial medicine, with the implication that they represent two independent activities. There is, of course, a proper distinction between the broader scope, objectives and responsibilities of the total industrial medical program and the more restricted ones of industrial hygiene. To an increasing degree, industrial physicians are concerned with the prevention and aleviation of all sorts of nonindustrial illness and with a variety of personal, domestic and community problems which affect the health, efficiency and well-being of industrial workers. Such problems have no peculiar relation to stresses of the industrial environment and certainly do not come within the scope of the physical scientists specializing in industrial hygiene. Respecting those problems which do arise out of the industrial environment, however, any tendency toward separation of medical and physical interests is unfortunate, for it weakens the basic concept of teamwork upon which industrial hygiene has been built and lessens the chance of arriving at the best solution of man-environment problems.

In order to preserve this concept it is essential to have one term which embraces the field and minimizes rather than emphasizes the differences between the detailed operations and procedures directed toward man and those employed for the control of the environment. This is the reason for the foregoing emphasis upon the joint scope of industrial hygiene. In support of the definition, which is not new, it will be profitable to review some of the principles of industrial hygiene and to consider the ways in which they modify and

extend the practices of the several professions within the team and how the teamwork does, in fact, result in greater accomplishments.

The subject is a fitting one for the Cummings Memorial Lecture and since the man we memorialize contributed so much to the establishment of industrial hygiene along the lines here considered. Certainly his own regrettably short career demonstrated the great good to be derived from effective welding of the medical and physical sciences. Starting as an engineer he concluded his work as Professor of Industrial Medicine on a medical faculty. Recalling his association with Gardner, it enhances rather than dims their separate accomplishments to reflect on how much each contributed to the progress of the other, one from the initial point of view of engineering and the other from the standpoint of experimental medicine.

Industrial Hygiene Technology

IN ONE SENSE, it is not necessary to formulate any particular arguments in support of industrial hygiene as a field of specialization nor to justify the joint participation of specialists from both medicine and the physical sciences in this activity. An impressive body of new knowledge and many advanced techniques have been developed to meet the special needs in the field, in medicine and allied sciences as well as in the physical sciences and engineering. Industrial toxicology, to consider one branch, involves research problems which certainly demand the highest skills of physical, organic and biological chemists, pharmacologists, pathologists, physiologists and clinicians. Biostatistics has become an essential tool in this field of research. The study of minute particulate matter in relation to dust disease calls for the most advanced tools of physical research. Some of the finest work in environmental physiology has been done in connection with industrial hygiene problems. The translation of the great volume of laboratory and field research into terms for use in the study, diagnosis and medical control of occupational diseases requires high skills along with advanced procedures of diagnostic and clinical medicine. The design of environmental control measures, of air-cleaning equipment, the redesign of machines and process equipment and design of new plants to insure healthful working conditions call, too, for special engineering capacities and techniques.

Thus the extensive technology contributed by the several professions is enough in itself to account for the increasing number of specialists in the field. Impressive as this is, nevertheless, there is a deeper reason for thinking of industrial hygiene as a joint field of specialization. This is the interdependence, mutual support and teamwork among the professions which characterize their activities. In importance, these transcend the separate skills and special techniques, valuable as they are.

Teamwork

THE CONCEPT of teamwork in industrial hygiene has been built up to the highest degree in America and is so much a part of our method of operation that we are apt to take it for granted and not reflect too much on its importance in the continuing growth of the field. The significant point which should be kept in mind is that we are dealing with man-environment relationships, and, for a full understanding of these, the man and the environment must be studied together. One depends upon medical and the other upon physical sciences, but it is the tying of the two together which explains the patterns of human response to environmental stress and makes possible the development of a systematic etiology and design of effective measures for the control of industrial health hazards. We have only to recall a few of the man-environmental relationships to make this point clear.

In thermal physiology, the physical laws of heat transfer have played a major part in the development of an understanding of the pattern of human response to heat and cold. The environments stress is physical; the internal situation is physiological, but the skin represents an overlapping zone where physical and physiological considerations are equally important. A parallel situation is seen in respiratory physiology. Laws of gas exchange are fundamental to an understanding of the rate of uptake of toxic vapors and gases, and an analysis of the respiratory system as a gas-liquid

equilibrating apparatus is of value along with physiological considerations in the study of industrial hygiene problems arising from gas and vapor exposures. The respiratory tract serves as a common meeting ground, being part of the environment, so to speak, as well as part of man. The etiology of the dust diseases, to use another example, is conditioned in large measure by the physical behavior of fine particulate matter in the air and in the respiratory tract, and favored theories of the action of dust in the lungs are also based upon physical properties of minute particles.

The beginning of teamwork in industrial hygiene was, of course, based upon simple and obvious needs. It came with recognition of the fact that studies of workers could not, alone, solve occupational disease problems and with the realization that a full understanding of the etiology of such diseases was as much dependent upon a detailed knowledge of the nature and behavior of the causative agent in the environment and the way in which it attacks man as upon the medical consequences in man himself. Teamwork, as a concept and basis for action, was greatly strengthened with the discovery of real and dependable relationships between the nature and magnitude of the stress of the environment and the nature, incidence and progression of the resulting disease. Out of these relationships emerged basic etiologic principles and facts and, of great practical importance, ideas of quantitative doses and of the specific conditions of exposure which were necessary for the disease to develop. The occupational history, showing definite evidence of exposure under the right conditions, became a basic tool for the identification of etiology as well as an important diagnostic tool, thus extending medical practice in industrial hygiene to include a quantitative consideration of the environment along with the strictly medical findings on man.

On the physical side, chemists and physicists were called upon to devise new methods of sampling and analysis not ordinarily employed in their own professions. Not only were they required to determine minute quantities of toxic agents, but they found that special sampling techniques and unusual analytical methods were often needed to reveal the proper information for determination of hazards to man. That is to say, the criteria for analysis were as much or more dependent upon physiological considerations as upon physical or chemical laws. Thus it became necessary to extend their knowledge outside the physical sciences and to modify their practices in accordance with physiological and medical factors. Similarly the engineer in industrial hygiene developed new procedures and practices beyond the ordinary limits of engineering, modified chiefly by the principles of medical science which are involved in the man-environment relationships of concern. Medical considerations, it was found, entered into the diagnostic procedures of the physical scientist in his appraisal of the environment, just as the occupational history conditions diagnosis of industrial diseases.

It is important to recall that these were mutual experiences and that the laws of human response to environmental stress which emerged from the joint study were held in common by the team. The essential facts concerning the etiology of occupational diseases became just as much a part of engineering and chemistry as of medical thinking, each profession having contributed basically to the development of those facts. This is the essence of the teamwork upon which industrial hygiene was built and continues to grow.

Group Response to Environmental Stress

IN STILL another respect has the development of industrial hygiene extended the outlook and modified the practices of the various professions in the field. The concept of quantitative relationships between environmental stress and human response is not naturally and immediately accepted either by the physician who is especially skilled in observing the vagaries of individual behavior nor by the scientist trained in the precise relationships of the physical world. The experience of one emphasizes the variability in man and tends to deny the existence of any physical basis for prediction of relationships; the other is not impressed with the usefulness of correlations among the variable observations on man and physical measurements of the environment.

Resolving these two points of view has been an important factor in the development of the field. Industrial hygiene is concerned with the prevention of ill-effects from environmental stress among groups of people. It is the relatively stable pattern of behavior of the group, in contrast to the more familiar individual variability in response, which enters into and makes possible the quantitative relationships in the etiology of occupational diseases. Relationships have in some cases been translated into the mathematical terms of familiar physical laws. The resulting equations do not, of course, replace physiological or medical considerations, but the fact that they can be written is of particular significance in dealing with the man-environment problems of industrial hygiene. A basis is thereby provided for translating human requirements into physical terms and thus the specific needs can be developed for essential improvements in the environment. On the medical side they are no less important for, when translated into terms of physiology and toxicology, an equally systematic foundation is laid for relating medical findings to work conditions and other details of occupational history. One development of outstanding value from this systematic approach is the concept of tolerance doses or so-called MAC values for toxic substances. In principle, this concept says that there is no absolute toxicity, but, rather, that toxic effects appear only when the dosage rate exceeds human capacity to dispose of the substance safely or to bring into action normal protective or compensating mechanisms. Tolerance levels in industrial hygiene also recognize and make allowance for man's ability to protect himself against taking in the damaging agent in the first place, thus distinguishing between basic toxicity (related to internal dosage rate) and practical hazard, which may be related to other factors in addition to simple levels of exposure. The reality of finite tolerance levels, at concentrations above zero, for the toxic materials employed in the industries is of the greatest practical significance for it makes possible the continued use of such substances under suitable conditions of control rather than their elimination, which would be otherwise necessary. In the chemical industry, in particular, large investments and the safety of many workers depend upon the correctness of the established hygienic standards or maximum tolerance levels.

Because of their importance, there is widespread interest in the lists of hygienic standards which have been developed for use in industrial hygiene and some confusion over the basis on which the levels are established. In part, confusion arises from the fact that several different criteria are necessarily employed for fixing the acceptable levels of exposure, depending upon the nature of the problem. The chronic poisons, with long-delayed manifestations of damage, present quite a different problem from the acute toxic agents which produce their effects immediately and from which recovery, if at all, is complete. Still another situation arises with substances which are irritating and even temporarily disabling but do not produce clear-cut medical problems. And finally there is the problem of disagreeable materials, disliked by all who encounter them which, however, are in no real sense toxic. Clearly the criteria for establishing tolerance levels for these four categories of substances must be quite different and the relative seriousness with which proposed levels are viewed must also differ greatly from one end of the scale to the other. To add to the confusion, a few proposed standards are derived from practical engineering considerations with no toxicological or medical basis whatever.

Our most dependable hygienic standards were developed principally from epidemiological analysis of actual industrial experience involving equally detailed observations and measurements of the conditions of exposure and of the effects of such exposure upon the workers. From these parallel sets of data there emerged systematic correlations between level and duration of exposure and incidence and magnitude of effect, from which, in turn, tolerance limits were established as the maximum levels of exposure which produced no significant effects. Such studies are time-consuming and costly. These and other practical considerations have made it necessary to employ less direct technics in many instances and even to establish standards for certain sub-

stances, based upon little more than assumed similarity with other materials. Moreover, new toxic substances are constantly being introduced into the industries, or are proposed for use, for which reasonable safety standards must be set in advance of any extensive human experience.

Preliminary research and indirect methods for setting tentative standards are necessary, but proof of the correctness of tolerance levels can come only from subsequent analysis of human experience in relation to recorded measurements of the conditions, magnitude and duration of exposure to the deleterious agent. The development, largely by the U.S. Public Health Service, of the epidemiological procedures for the collection and the analysis of such data is an outstanding contribution of teamwork in industrial hygiene. It is hoped that that organization, other official agencies and the industries will continue to record and analyze the findings from actual industrial experience so as to replace in our lists of tolerance levels the large number of values which now appear without adequate supporting evidence.

Expanding Opportunities in Industrial Hygiene

THE PRINCIPLES and practices of industrial hygiene have been developed and its practical usefulness as a field of specialization has been demonstrated largely in the control of occupational diseases. In a sense, this is a self-limiting activity for, the more successful the program, the sooner are the occupational disease problems solved. Indeed, we have seen this happen in a number of industrial establishments where toxic substances, like lead, for example, are now in regular use in large quantities without any attendant problems of intoxication. The control program has been reduced to a routine, maintenance basis. New problems in toxicology will be presented, of course, in a never-ending stream, but the essential procedures for attack upon them are now well developed.

On the other hand, there are many unsolved human problems arising out of the stress of modern industry to which the principles and practices of industrial hygiene can be usefully applied despite the fact that these stresses do not result in frank disease. They do, however, affect many more people than do the toxic materials and, in total, the effects are more far-reaching. One such problem of great practical importance has to do with the selection and placement of the worker in relation to the job so as to obtain the highest degree of adjustment between the two and thus to insure minimum physiological and psychological stress and maximum satisfaction to the worker along with high productivity. This requires the development of quantitative methods for the measurement of human capacities and limitations (anatomical, physiological and psychological) in relation to external stresses of various kinds and for the identification and measurement of the actual stresses imposed upon the worker by different jobs and by the industrial environment. Given such methods of measurement, jobs can be analyzed systematically and specifications prepared against which equally systematic measurements on man can be compared. These, of course, are the objectives of the specialists in personnel work, in time and motion study, in industrial engineering and other management activities.

Progress has been made but much remains to be done; many empirical procedures now in use require systematic evaluation and translation into more basic terms. It is significant that the concept of teamwork among the several professions in this area is not developed to the high state which characterizes industrial hygiene. Industrial psychologists and industrial engineers are not working as closely together; the industrial physician plays no major part in the program, beyond conducting more or less routine pre-placement examinations, the findings of which are interpreted only in the broadest way in relation to job requirements; no environmental physiologists are regularly employed in industry; engineers continue to design process equipment and machines with little understanding of the capacities and limitations of man or how these can be translated into proper terms for use in engineering design. Even the most elementary data of physical anthropology are not to be found in regular use in the design of machines or analysis of jobs. The engineering specialist in time and motion study, whose work impinges most

vitally upon human problems in the industries, should certainly maintain the closest relationships with physiologists and psychologists skilled in the methods of observation and analysis of man-environment relationships in their respective areas.

As the mechanization of the industries advances, these problems increase in importance. The human requirements in the design of industrial machines demand more and more attention. So, too, do many problems of the industrial environment. Noise, for example, once accepted without complaint, is now receiving increasing attention, not only because of its potentially damaging effect upon hearing but on account of its effect upon communication as well. Comfort-conditioning is replacing the elementary heating and ventilation of earlier days. Design of lighting systems is becoming more refined and more closely related to the specific visual requirements of the job and to the visual capacities and limitations of man. Matters of even more subtle concern, such as the influence of color in the environment now receive serious attention. Increasing amounts of space within the factory and outside are being devoted to the needs of workers in recognition of the great value of human resources in industrial operations.

For the most part, we think of industrial hygiene in terms of negative situations, always involving hazardous conditions of work. With the successful removal of many hazards from industry, however, there has come a shift in interest toward positive situations where opportunities exist for actually increasing the well-being of industrial workers. The great challenge to dynamic industrial hygiene is to create surroundings in technology which will make the most of the hereditary possibilities of the workers. Mental as well as physical welfare depends to a considerable degree on the environment. As improvements are made in the conditions under which persons work, these persons will be given better opportunities to develop their capacities and to become well-adjusted and happy. Here, we are no longer satisfied merely to operate within tolerance limits but, rather, the objective is to secure and maintain optimum conditions for work. In the name of a rather general objective called worker morale, considerable effort and funds are being expended by progressive industrial organizations. The direction in which this work is carried is now based, however, upon little more than empirical relationships, assumptions and opinions. There is great need for describing optimum conditions, like our tolerance standards, on the factual basis of established laws of human behavior in relation to stimuli of the environment. As in the earlier accomplishments of industrial hygiene, these can be discovered only through teamwork, involving psychology and sociology along with medicine and physiology, working closely with the physical scientists and engineers.

Industrial progress over the past fifty years has been in proportion, principally, to advances in technology—advances which have come from industrial research and production engineering. As a result, the art and empiricism of an earlier day have largely given way to precise methods and a high degree of technical control. The technological changes have supplanted the art of job performance, however, and with the art and craftsmanship went much of the satisfaction in a day's work. Thus the very technical progress of the industries has created a major share of the human problems which confront them today. There has not been a comparable advance in the understanding of these human problems nor in the technique of dealing with them. In respect to the protection and use of human resources, the industries are still in an empirical stage comparable to the beginning period of modern technical control of physical resources. Outstanding advances in personnel management of the future will be in the direction of organizing and systematizing the handling of human resources on a more factual basis, with resultant benefits to our industrial society comparable to those which have come from the technological progress of the past half-century. Industrial hygiene, because of its unique welding together of the medical and physical sciences, can contribute significantly to this progress, for it has established a successful pattern for dealing with man-environment problems, jointly involving the knowledge and skills of these two broad professional groups.

Off-Site Disposal of Radioactive Incinerator Residues by Solid Fluxes

RICHARD C. COREY
Supervising Engineer, Combustion Research Section
HARRY PERRY
Chemical Engineer, Combustion Research Section
CECIL H. SCHWARTZ
Fuel Engineer, Combustion Research Section
Coal Branch, United States Bureau of Mines
Pittsburgh, Pennsylvania

Introduction

THE potential benefits of using radioisotopes for research and medical therapy are now well known, and as the result of developments by the United States Atomic Energy Commission in the production and handling of low-cost radioisotopes for general use, it is expected that increasing numbers of off-site institutions, such as medical clinics, hospitals, and universities, will adopt their use.

To prevent contamination of personnel and the air and ground waters, elaborate precautions are necessary in disposing of radioactive waste materials. When such materials are combustible, incineration is the most suitable means of disposal, since a 10- to 15-fold reduction of waste volume is attained. However, both the ash and the products of combustion from an incinerator present a special disposal problem in off-site areas, because the surrounding areas may be heavily populated, the service personnel in charge of waste disposal may not be technically trained, and the extensive waste disposal facilities of AEC sites are not readily available.

Anticipating the needs in this respect, the Atomic Energy Commission contracted with the United States Bureau of Mines to develop an incinerator for off-site use that would handle low-level, heterogeneous wastes containing cellulosic materials; animal carcasses, viscera, and excreta; and miscellaneous combustible laboratory wastes.

An incinerator for this purpose comprises three separate design problems: (1) A combustion chamber that will burn wastes of widely varying combustibility as completely as possible, with minimum carry-over of particulate matter in the combustion gases. (2) An efficient gas cleaning system that will remove the maximum amount of particulate matter from the combustion gases. (3) An ash receiver from which the ash, the specific radioactivity of which may be many times that of the original charge, can be removed for ultimate disposal without danger to operating personnel.

Each of these phases of the design of an incinerator for off-site use is currently being studied by the Bureau of Mines. However, owing to certain unique circumstances of off-site use of an incinerator, methods for handling the ash have received special attention, and it is the purpose of this paper to report the results of this part of the work.

Handling Incinerator Residues

MANUAL cleaning of dry ash from the ash receiver of the incinerator obviously cannot be tolerated, nor can the ash be discharged to the sewer as a slurry, which precludes wet collection. Furthermore, storage of slurries of ash for shipment to ultimate disposal points is not feasible in off-site hospitals and laboratories, where weight and volume of waste are important factors to be considered, and, more important, where the handling of such materials may be in the care of non-technical personnel.

These considerations suggested that if the ash were removed from the incinerator as a compact, dry, solid mass it would occupy a relatively small volume, and could be handled and shipped more easily to the final disposal point. It was decided, therefore, to design the ash receiver of the incinerator so that the ash falling from the grate would be caught in a disposable re-

ceptacle containing a molten inorganic compound, where it would be completely dissolved and could be removed later, in toto, as a solid mass and shipped to the disposal point. Since the flux would not be removed from the container when it had reached its capacity for ash, personal contact with the charge would be unnecessary.

Prior to designing the ash receiver, bench-scale studies were made to determine the most suitable material for a flux, the basic requirements for which are as follows:

1. It must be inexpensive and easily purchased.
2. It must be solid at nominal room temperatures, but completely molten at the lowest possible temperature above room temperature, when saturated with typical ashes.
3. It must have as high as possible a specific capacity for dissolving ash, so that a given weight of flux will handle the ash from a reasonably large volume of charge to the incinerator.
4. It must have a relatively low vapor pressure at its maximum operating temperature to minimize loss of flux by volatilization, and to prevent deposition inside the incinerator of products of volatilization.
5. It must not react explosively with any of the constituents of typical incinerator residues.
6. It must attack to a negligible extent the metal container in which it would be heated, during the maximum time that the charge would be molten.

The chemical and physical properties and the unit cost were evaluated for a number of relatively low-melting chlorides, nitrates, sulfates, and hydroxides, and various complex mixtures of these compounds, to determine the most suitable material, with respect to the requirements previously described. Sodium and potassium hydroxides appeared to meet the requirements of low cost, low-melting temperature and vapor pressure at that temperature, and adequate solvent capacity for the major constituents of typical ashes. It was necessary, however, to make bench-scale studies with both compounds to determine quantitatively (a) the effect of various amounts of typical ashes dissolved in the fluxes, (b) the specific capacity for dissolving typical ashes, and (c) the rate of corrosion of plain carbon steel in contact with these compounds.

With reference to the corrosion tests, it was decided to use containers fabricated of plain carbon steel instead of any of the more expensive ferrous alloys, since the flux and container would be disposed of as a unit to avoid handling the flux after it had reached its capacity for ash.

Experimental Work

PREPARATION AND PROPERTIES OF ASH SAMPLES: Typical residues from incinerators consist largely of ashes from hardwood, softwood, paper, cloth, and bone, mixed with varying amounts of unburned carbon, and it was decided to use these materials for the present studies. Excepting the bone ash, which was a commercial grade, the other ashes were obtained by burning the respective material in a laboratory pot stove. The residues purposely were not burned completely, so that some unburned carbon would remain, simulating actual incinerator residues. Each was screened through a 12-mesh screen and a representative sample was analyzed for combustible content. Chemical analyses were made on completely ashed samples.

The physical properties of these ashes are given in Table 1.

TABLE 1.
PHYSICAL PROPERTIES OF ASH SAMPLES USED IN THE FLUXING STUDIES

Type of Ash	Softwood Charcoal	Hardwood Charcoal	Cloth	Paper	Bone
Physical Properties:					
Fusibility of Ash, °F					
Initial Deformation Temperature	2730	2720	1880	2800	2840
Softening Temp.	2760	2730	2030	2830	2860
Fluid Temperature	2760	2730	2170	2910	2890
Bulk Density, lb/ft^3	28.7	20.0	15.0	10.6	54.9
Packed Density, lb/ft^3	53.8	45.3	42.4	37.3	87.0
Absolute Density, lb/ft^3	137	141	115	141	176

The cone-fusion temperatures were determined according to ASTM Standard D 271-46. Density determinations were made with samples containing unburned carbon, excepting the bone ash, which did not contain free carbon. The *bulk density* was determined by measuring the volume of a known weight of the ash after shaking to aerate it thoroughly. The *packed density* was that found after tamping the

charge until the volume change was negligible. The *absolute density* was determined by water displacement, which gave only an approximate value because of the slight solubility in water of certain constituents of the ash. A more precise determination was not required for this investigation.

The chemical composition of the samples, expressed as the oxides of the constituents, is given in Table 2.

X-ray diffraction patterns also were made to identify the major compounds present. The patterns of the wood ashes showed the major phases present to be CaO and $CaCO_3$, with minor amounts of alkali metal carbonates. The patterns of the paper and cloth ashes showed relatively strong lines corresponding to aluminum silicate and barium sulfate, probably resulting from filler and sizing in the original materials. The pattern of the bone ash showed hydroxyapatite to be the main constituent, which was mixed with a minor quantity of what appeared to be an ignited form of tertiary calcium phosphate.

TABLE 2.
CHEMICAL ANALYSIS OF ASH SAMPLES USED IN FLUXING STUDIES

Source of Ash	Hard-wood	Soft-wood	Cloth	Paper	Bone
Proximate Analysis					
As Received, Percent					
Moisture	1.1	1.4	2.6	1.4	0.1
Combustible	24.5	34.8	24.8	11.3	0.3
Ash	74.4	63.8	72.6	87.3	99.6
Moisture Free, Percent					
Combustible	24.8	35.3	25.5	11.4	0.3
Ash	75.2	64.7	74.5	88.6	99.7
Chemical Analysis, Percent (Combustible-free)					
Moisture	0.0	0.0	0.1	0.5	0.1
Ignition Loss (excluding H_2O and CO_2)	0.0	2.1	0.0	0.5	0.0
SiC_2	2.5	5.5	24.7	23.5	0.5
Al_2O_3	2.0	2.0	10.7	25.6	0.2
Fe_2O_3	4.7	4.1	15.7	1.7	0.3
TiO_2	0.1	0.1	3.1	0.4	0.0
P_2O_5	2.8	1.9	1.2	0.3	41.0
Mn_3O_4	3.8	1.9	0.7	—	—
CaO	50.8	63.7	11.3	3.6	54.2
MgO	5.2	3.6	4.5	2.7	1.2
SO_3	1.7	1.8	9.0	13.3	0.4
CO_2	9.0	3.2	0.2	—	—
$Na_2O + K_2O$	17.4	10.1	11.3	5.1	2.1
Cr_2O_3	—	—	7.5	—	—
BaO	—	—	—	13.3	—

FLUXING CAPACITY OF SODIUM AND POTASSIUM HYDROXIDES. The fluxes selected for study were chemically-pure grades of sodium hydroxide and potassium hydroxide, and a 40-60 mixture of sodium and potassium hydroxides. The first two melt at 605° and 715° F, respectively, and the binary mixture at 333° F, which is the minimum melting point of this system.

These melting points are affected by the addition of other compounds with which the fluxes are miscible. Consequently, the amount of a particular ash that a flux will dissolve is limited by the temperature to which the flux is heated. However, this temperature in turn is limited by the rate of corrosion of the container by the molten charge. For reasons mentioned previously, it was desirable to use plain carbon steel containers, and it will be shown later that, under the conditions of incinerator operation, the rate of corrosion by sodium hydroxide is negligible at 1000° F. A somewhat higher temperature might be used safely insofar as internal corrosion is concerned, but above 1000° F the rate of corrosion of low-carbon steel in contact with air increases rapidly, and the surfaces of the container exposed to air would thin at an excessive rate.

The method for determining the effect of the different ashes on the melting point of the fluxes consisted of heating a weighed amount of flux well above its melting point, adding a weighed amount of ash, and measuring the temperature of the mass at regular intervals while it slowly cooled. The first change in the rate of cooling corresponds to the first separation of solid phase, or the beginning of freezing of the mixture. The freezing temperature was determined for a series of mixtures with different percentages of ash, and the locus of the freezing temperatures plotted against composition of the mixture gave a characteristic curve for each flux-ash combination. The results for sodium hydroxide and the various ashes are shown in Fig. 1. They are given on the basis of a combustible-free ash in Fig. 2. It will be noted that as the percentage of ash increased the freezing temperature first decreased slowly and then increased rapidly.

The flux-ash melts are very viscous at the freezing temperature, and the rate of solution of ash at a given flux temperature diminishes rapidly near the saturation point. Therefore, to afford ample fluidity of the melt at all times, it was decided to operate the flux at a temperature 200° F

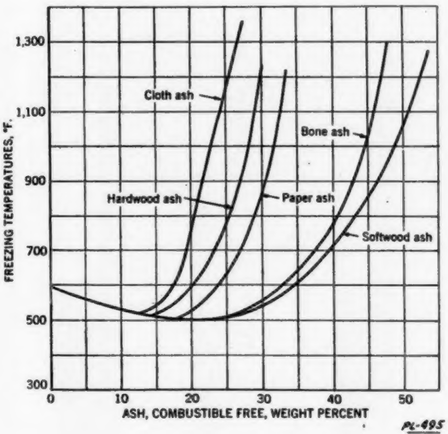

Fig. 1.
Freezing Temperature — Composition curves for various ashes fluxed with sodium hydroxide (As-received basis).

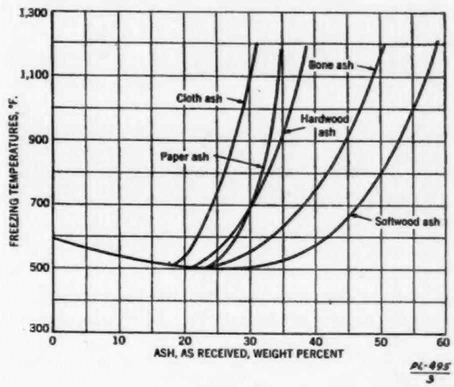

Fig. 2.
Freezing Temperature — Composition curves for various ashes fluxed with sodium hydroxide (Combustible-free basis).

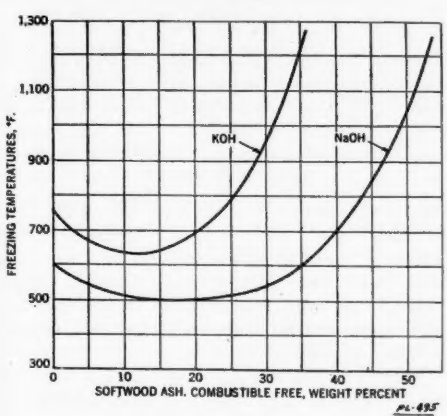

Fig. 3.
Comparison of Freezing Temperature — Composition curves for softwood ash fluxed with sodium hydroxide and with potassium hydroxide.

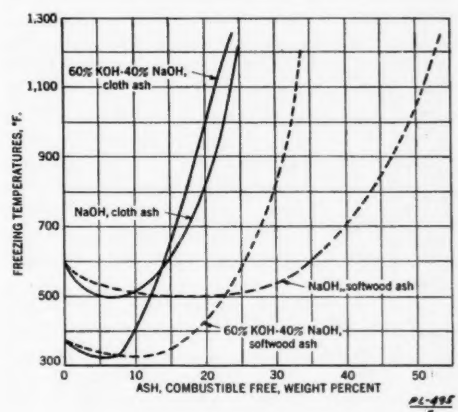

Fig. 4.
Comparison of Freezing Temperature — Composition curves for different ashes fluxed with sodium hydroxide and with a 60:40 mixture of potassium and sodium hydroxides.

higher than the freezing temperature. Since the maximum operating temperature was selected as 1000° F, the specific capacity of sodium hydroxide would correspond to the weight of a particular ash dissolved at 800° F. For example, at a temperature of 800° F, 100 pounds of sodium hydroxide would dissolve approximately 20 pounds of cloth ash, 35 pounds of hardwood ash, 40 pounds of paper ash, 65 pounds of bone ash, and 75 pounds of softwood ash, all on a combustible-free basis.

Similar tests were made with potassium hydroxide, which melts at 715° F, using only softwood ash. The results are compared with those for sodium hydroxide, in Fig. 3, and it is seen that the capacity of potassium hydroxide at 800° F is considerably less than that of sodium hydroxide.

The effect of various amounts of cloth ash and softwood ash on the freezing temperature of a 40-60 melt of sodium and

Fig. 5.
X-Ray diffraction patterns of softwood ash before and after fluxing with sodium hydroxide.

potasium hydroxides was next determined. The results are compared in Fig. 4 with those of sodium hydroxide, and it is noted that despite the lower freezing temperature of the binary mixture, its solvent capacity for these ashes is considerably less than that of sodium hydroxide.

Confirmation of the fact that the flux combines chemically with the various ashes was found in x-ray diffraction patterns of the final melts. This is typified in Fig. 5 where a pattern of softwood ash is compared with that of a melt of sodium hydroxide containing 60% of softwood ash. It will be noted that the corresponding lines of the original ash do not appear in the melts, signifying complete reaction with the flux.

It is considered particularly significant that the final volume of a melt containing the optimum amount of ash is not appreciably different than the bulk volume of the original ash. This is shown in Fig. 6 for cloth ash and sodium hydroxide, and it may be concluded that the use of a flux does not contribute to the volume of solids that must ultimately be disposed of.

RATE OF CORROSION OF LOW-CARBON STEEL IN MOLTEN SODIUM HYDROXIDE. Previously, it was noted that a temperature of 1000° F would represent the maximum safe temperature for steel containers in air. A spread of 200° F was considered essential to insure sufficient fluidity of the melt when it contained amounts of ash corresponding to 800° F (Figs. 1 and 2), and to provide sufficient temperature gradient from the container to the melt to compensate for heat losses from the top of the melt. It was desirable, therefore, to determine the rate of corrosion of plain low-carbon steel in sodium hydroxide at 1000° F. The corrosion rate of cast iron had been determined under these conditions,[1] and was found to be relatively low, but there was no assurance that steel would behave similarly.

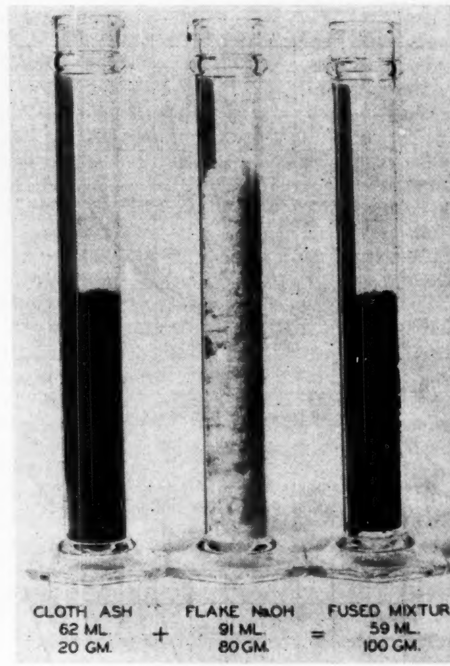

Fig. 6.
Effect of fluxing cloth ash with sodium hydroxide on relative volumes.

Strips of low-carbon steel, each 0.0813 cm x 1.0 cm x 10 cm, were pickled at 150° F in 5% sulfuric acid containing an inhibitor to remove mill scale and rust, and then were washed successively with carbon tetrachloride and alcohol, and dried and weighed. The strips then were immersed in a bath of molten sodium hydroxide, which was maintained at 1000° F. Specimens were removed each day for a period of three days, each being pickled, washed, dried at 200° F and weighed.

The corrosion rate was calculated from the change of weight and the measured area of each specimen, and was expressed in the usual unit, inches penetration per year. The results are plotted, together

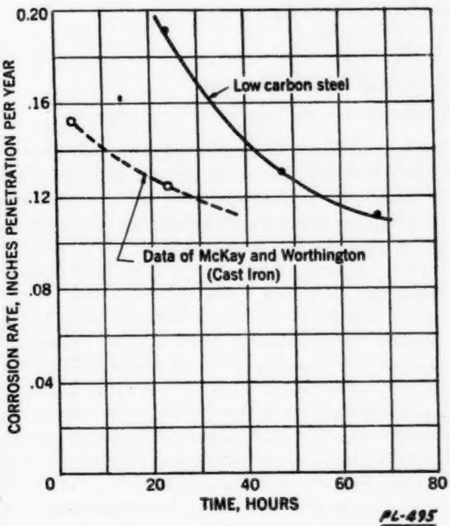

Fig. 7.
Corrosion rate of cast iron and low carbon steel in molten sodium hydroxide at 1000°F.

with those for cast iron, in Fig. 7. If the corrosion rate after 72 hours is used for calculating the thickness of metal required for the flux container, a conservative estimate of safe thickness will be obtained.

It has been tentatively decided to design the incinerator so that the container may be easily removed from the incinerator. Steel pots, filled with a fixed charge of sodium hydroxide, will be used for a predetermined number of hours and then replaced with a new pot and charge of sodium hydroxide; the used pots, containing the incinerator residue, being shipped to a central disposal plant.

If a standard charge of 100 pounds of sodium hydroxide is used, approximately 25 pounds of ash can be fluxed, which represents approximately 2500 pounds of refuse with 1% ash. For a burning rate of 50 pounds per hour of refuse, and assuming that the flux is kept molten throughout the operation of the incinerator, the flux pot will have been heated for a period of 50 hours. Referring to Fig. 7, this would correspond to a corrosion rate of 0.121 ipy, or, a penetration of 0.00083 inches in 50 hours. For a factor of safety of 100, this would correspond to a wall thickness of the flux pot of 12 gage, which would be easy to handle and would have adequate strength.

During the corrosion studies an unexpected phenomenon was noted that must be considered in the design of the flux pot. The molten sodium hydroxide had a marked tendency to "creep" from the container in which it was heated. Qualitative tests showed the rate of "creep" to increase with temperature, and for a given temperature to depend upon the percentage of ash, shape of the container, and the kind of metal from which the container was constructed.

Although confirming tests must yet be made, it is believed that "creep" of the flux from the pot can be prevented by suitable cooling of the top portion of the pot—a provision that can be easily incorporated in the design of the adapter for the pot.

Conclusions

FLUXING radioactive residues with molten sodium hydroxide, as an integral part of the operation of an incinerator, appears to be a feasible means for handling and disposing of such residues safely. One hundred pounds of molten sodium hydroxide, at a temperature of 800° F. will dissolve from 20 to 75 pounds of combustible-free ash, depending upon the source of the ash. Owing to the low unit cost of commercial grades of sodium hydroxide, and to the use of plain low-carbon steel pots for retaining the flux, the cost of this operation will be a negligible factor in the over-all operating costs of the incinerator.

GRATEFUL acknowledgments are due: The United States Atomic Energy Commission for permission to release this paper; LOUIS C. MCCABE, Chief, Fuels and Explosives Division, United States Bureau of Mines, and ARTHUR E. GORMAN, Sanitary Engineer, Atomic Energy Commission, for helpful suggestions and review of the paper; and W. A. SELVIG, Chief, Miscellaneous Analysis Section, ROY F. ABERNETHY, Chief, Coal Analysis Section, and L. J. HOFER, Physical Chemist, United States Bureau of Mines, for the analyses entailed.

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A Gas Ejector for Air Sampling

LYNN D. WILSON, Ph.D.
Wilson Industrial Hygiene & Research Laboratories
Chicago, Ill.

IN AN EFFORT to relieve the tedium of sampling with the midget impinger and possibly to increase the dignity of the operation, an extended search was made for a suitable substitute mechanism. Recourse to line operated blower or suction units was early abandoned because of the wide variations in available power sources, especially in the Chicago area. These range from 110 v 60 cycle, 110 v 25 cycle, 220 v 3 phase and 440 v 3 phase to DC of various voltages. A thorough consideration of the possibilities of battery operated units resulted in similar abandonment in view of the power required to overcome the pressure differential across the impinger orifice.

The use of compressed air with a Hancock ejector was described by Hatch, Warren and Drinker[1] but the unit is limited in use to locations where compressed air is available and would not be suitable for use in crane cabs etc. In the arrangement shown here, compressed air for use with the ejector is replaced by bottled carbon dioxide, which, being in the liquid state, maintains a constant vapor pressure subject only to the ambient temperature. The unit consists of small cylinder of carbon dioxide, a needle valve to control the flow of gas, an ejector to provide the suction, and a vacuum gage such as used with MSA midget impinger. A commercial cylinder (approx. dimensions, 3½ in. x 14 in.) weighing about 4.7 lbs. empty with a capacity of 2.5 lbs. is coupled directly to a needle valve the outlet of which feeds the ejector. A T-connection on the suction side of the ejector is coupled to the vacuum gage. While no attempt has been made to design the most efficient ejector, present design allows for the consumption of 10 oz. of carbon dioxide per hour. With a fully charged 2.5 lb. cylinder, sufficient gas is available for 24 determinations per day using the midget impinger. The arrangement makes for maximum portability and allows sampling without the constant attention of the operator or the expenditure of considerable energy in turning the hand pump. The equipment is now being developed for the market by the Mine Safety Appliances Company.

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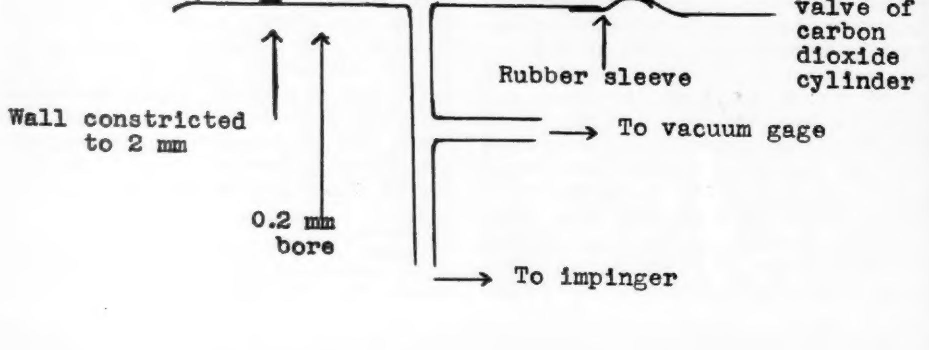

The Development of Prototype Model Research on Atmospheric Pollution Problems

GORDON H. STROM, Ph.D.
Associate Professor of Aeronautical Engineering; Director of Windtunnels
and
WILLIAM T. INGRAM, M.P.H.
Associate Professor, Public Health Engineering
Executive Secretary, Air and Water Pollution Research Section, Research Division
New York University, College of Engineering

THE control of atmospheric pollution offers a challenge to engineers that parallels and perhaps surpasses in magnitude challenges created by the demand that water supplies of the nation be made safe; that the streams and other waters be freed of harmful pollution, that the workroom environment be controlled so that workers are not unwittingly subjected to occupational hazards.

Historically, smoke abatement has been sought and has been gained in some degree in many urban areas. The wider range of air polluting substances that marks the growing industrialization of the United States is well demonstrated by the often-quoted studies at Donora, Pennsylvania, and Los Angeles, California. These studies are only the forerunner of an intensification of effort on the part of many professional interests to inquire into the behavior of pollutants in an open atmosphere.

The authors offer in this paper a report of progress in the development at New York University of prototype model facilities for the study of atmospheric pollution. Since 1948 the College of Engineering Research Division has been carrying out a program of wind tunnel development for atmospheric pollution research.

The immediate program objective has been construction of a wind tunnel for the study of stack gas dispersion problems associated with industrial installations. The long-range objective is the development of a meteorological wind tunnel in which the important atmospheric motions affecting pollution will be simulated.

Atmospheric pollution problems arising from industrial processes are being approached from two directions, namely the elimination of the pollutant at the source and dispersion of the pollutant once it is discharged to the atmosphere. While much can be done towards the reduction of the amount of pollutant, a point is often reached where further reduction becomes extremely costly and increased attention must be given to the means of improving the dispersion of the pollutant in the atmosphere. If, before reaching ground level the pollutant is dispersed so that the concentrations are no longer objectionable, the problem of pollution from a given source may be solved. There remains, however, the much larger problem of cumulative concentration of pollution from a number of sources in a given region.

Atmospheric motions involved in the dispersion of gases from stacks are extremely complex. Since no accurate analytical methods exist for predicting such motions, particularly, when the effects of surrounding structures are included, it is only natural to turn to prototype studies for the solution of stack gas dispersion problems. The moving airstream of the wind tunnel is the logical place to make prototype studies from which the effect of natural winds on the dispersion of gases may be interpreted.

Numerous wind tunnel prototype studies on atmospheric pollution have been made over a period of many years. Most of them have been concerned with the dispersion of stack gases from industrial plants. Some of these studies were made either to find a solution for a pollution problem that developed when a plant was completed or to avoid a pollution problem in a proposed design. In practically all cases the problem was treated as one involving aerodynamic

Presented at a meeting of the AMERICAN INDUSTRIAL HYGIENE ASSOCIATION at Atlantic City, New Jersey, April 26, 1951.

phenomena of the model. Meteorological characteristics other than the wind speed were not reproduced in the wind tunnel. Omission of meteorological characteristics is not as serious as it may seem because the atmospheric motions which affect the dispersion of stack gases at relatively short downwind distances are due primarily to influence of building structures. Past prototype studies have been confined to limited downwind distances. Corrective measures also subject to that limitation are found that would be difficult if not impossible to find with analytical means. The point is illustrated in two photographs from wind tunnel studies conducted at New York University for the Consolidated Edison Company of New York (Fig. 1). The original building is as shown in the upper photograph. Modification accomplished by removing the projecting section of the main building (a 22% reduction in height) was treated in the lower photograph. The modified building created a greater turbulent wake which entrained the smoke plume and brought it to the ground close to the building.

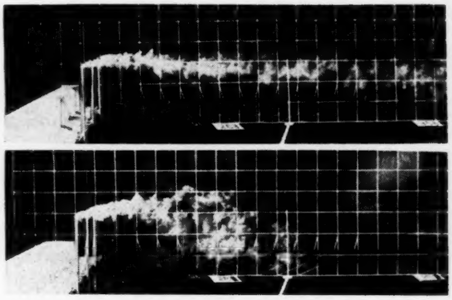

Fig. 1.
Reduction in height of the building as shown in the lower photograph has a detrimental effect on the plume characteristics. Wind speed and gas ejection speed are eight feet per second in both tests. (Courtesy of the Consolidated Edison Co. of New York, Inc.)

While studies of the type shown in Fig. 1 determine the most favorable building configuration they do not provide information on the degree of pollution at considerable downwind distances. The limiting factor is often the length of the wind tunnel working section. The more serious limitation is that of omission of the meteorological factors. These become increasingly important in analysis of the dispersion of pollutants from a given source as the region of interest is extended downwind and they play a major role in the pollution problems covering wide regions. The strength of wind is important. Also important is turbulent or eddy motion, the primary dispersing mechanism. While strong winds may carry the pollutant away rapidly, concentrations in its path may be high if it is not dispersed by the turbulent motion. The degree of turbulence may vary widely and is influenced by such factors as thermal conditions in the atmosphere and configurations of the earth's surface upwind of the polluted area. Until such control is introduced, wind tunnel studies will be confined to the limited region affected primarily by building turbulence.

Whether all the atmospheric motions or a major portion of them can be simulated at a reduced scale in a wind tunnel is open to question. Experiments carried out in Germany nearly two decades ago in a so-called hot-cold wind tunnel gave some hope of success. At this wind tunnel the surface above the airstream was heated and that below was cooled to establish a temperature gradient in the stream. This temperature gradient had a pronounced effect on turbulence of the airstream. The temperature gradient in the atmosphere has a pronounced effect on atmospheric turbulence. While the scale of the turbulence in the wind tunnel is much smaller than in the atmosphere, the German experiments displayed phenomena related to atmospheric motions that may be utilized in prototype studies. Aside from the German experiments it appears that very little progress has been made in the development of a wind tunnel for the simulation of the meteorological characteristics of the atmosphere, that is, a meteorological wind tunnel. Skepticism about the ultimate success and cost of development are among the factors which have delayed the progress. Perhaps the most important deterrent has been the lack of accurate knowledge of atmospheric characteristics. Meteorological field studies, now being carried out by several groups, are rapidly removing this barrier to wind tunnel development. An ex-

cellent example of such studies is the work being done at the Brookhaven National Laboratory. Continuous records of important atmospheric characteristics at a number of levels up to 455 ft. are being obtained at the meteorology tower.

The meteorological wind tunnel for atmospheric pollution studies will differ considerably from the wind tunnels used in the past. In place of a uniform airstream the new type tunnel must produce a stream which simulates the widely varying non-uniform characteristics in the lower layer of the atmosphere. In its first development the meteorological wind tunnel will reproduce those characteristics of the atmosphere which vary with height above the earth's surface. In addition to vertical variations in wind speed, control of the temperature distribution must be achieved. Not only must these characteristics be accurately maintained for a given test but they must also be capable of adjustment over a wide range. The range on temperature controls extends from the inversion condition wherein the temperature increases with height, to the lapse condition wherein the temperature decreases with height. Artificial devices, having no counterpart in the atmosphere will have to supplement natural means to obtain the desired control of the airstream.

The characteristics of the atmosphere at a given location are the result of both the conditions at the location and the prior upwind influences originating over considerable distances. These prior influences include the thermal and topographical characteristics of the earth's surface as well as characteristics of higher levels of the atmosphere. It is obviously impractical, if not impossible, to represent these prior influences in a wind tunnel, although they may be achieved to a limited degree with the use of a long entering section. It appears more practical to "condition" the entire airstream at the entrance to the test section where the observations will be made. This calls for devices which control the temperature and velocity of the airstream at every level. Downwind of the entrance section where the "conditioning" has taken place the thermal and topographical characteristics of the surface will be simulated. These will influence the phenomena which develops in the test section.

The design and construction of the equipment for a meteorological wind tunnel, each offering problems in themselves, constitute only one phase of a complete program of development. The results of a thorough experimental investigation of characteristics of the wind tunnel airstream will be correlated with atmospheric field experiments and theories of atmospheric turbulence and gas diffusion. While considerable progress has been made in atmospheric field experiments the need for further knowledge of the fundamental characteristics of the atmosphere and the diffusion of pollutants will continue.

Although the development of the wind tunnel will be limited by the extent of the knowledge of full-scale phenomena, this fact should not be used as an excuse for delaying the development of a meteorological wind tunnel. To the contrary, the wind tunnel may be expected to contribute to the study of atmospheric phenomena. Controlled experiments in the wind tunnel with the advantages of reproducibility and systematic variation of individual parameters will aid in the analysis of full-scale atmospheric phenomena and the development of theory.

AN IMPORTANT phase of necessary correlative studies is the establishment of the scale or similarity factors that affect scale model experiments on atmospheric pollution. The use of scale factors—those combinations of variables which express a fixed relation between specific phases of a physical phenomenon—is universal in model studies and is almost indispensible in the preparation and interpretation of scale model experiments. In the complex motions of the atmosphere there appear several scale factors of importance such as Reynolds, Richardson and Froudes numbers. It will be impossible to generally maintain full-scale values of all the factors in model experiments simultaneously. The manner in which the physical phenomena vary with the scale factors will be the subject of an extensive investigation in the development of the meteorological wind tunnel and must be approached through theoretical as well as experimental studies.

As is common in prototype testing to a reduced scale, the development of theory and techniques for atmospheric pollution experiments in the wind tunnel will follow two general lines. During the present stage where the theory and the experimental characteristics of atmospheric phenomena are incomplete, empirical relations between wind tunnel and field experiments are necessary to obtain the first practical use of the wind tunnel. Real progress can be made only when the fundamental characteristics determined by theoretical and experimental investigations of the wind tunnel airstreams become better known.

Proceeding along the lines discussed, the immediate objective of the New York University development of a wind tunnel for the study of the effect of building turbulence and stack variables on gas dispersion has been accomplished under the sponsorship of the Consolidated Edison Company of New York. A number of scale model studies on power plant characteristics have been carried out. In addition to supplying the desired design information, the past investigations have given a background of experience of great value to the present program. Many of the equipment problems to be encountered in the development of control apparatus became evident in the earlier operations. Major effort on the present project sponsored by the Atomic Energy Commission is directed toward development of equipment for simulating meteorological characteristics in the wind tunnel airstream.

The original wind tunnel with the modifications now under development is shown in Fig. 2. Air, controlled in the working section at wind speed velocities ranging from three to 20 feet per second, is drawn from the interior of the building and exhausted through the roof. Exterior exhaust is necessary to avoid contamination of interior air by smoke used in model experiments. Glass windows along one side of the 30 ft. working section permit photographic studies of model smoke experiments. Three cameras synchronized with electronic flash lamps are used to record the smoke trails. A continuous supply of smoke is produced by an oil fog smoke generator.

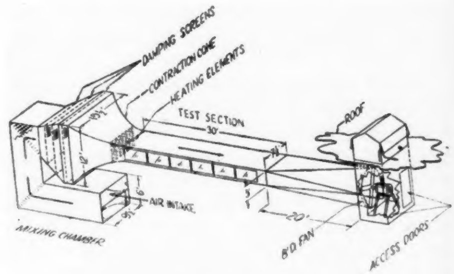

Fig. 2.
Wind Tunnel at New York University designed for atmospheric pollution studies showing modifications now under development.

Originally, wind tunnel air was drawn from within the building through the contraction cone ahead of the working section. It was found that temperature stratification occurred in the airstream as a result of temperature differences in the room. This temperature stratification varied as fresh air was drawn into the building. In the design of the modifications for control of stream characteristics it was decided to mix the entering air thoroughly to remove the temperature stratification. Turbulence generated by the mixing process will be eliminated with vanes and screens in a length of conduit and in the diffuser where the air is brought to a low velocity before it is accelerated in a contraction cone. Temperature and velocity controls will be applied to the airstream in vertical cross sections at the end of the contraction cone shortly before the air enters the working section. Heat will be introduced with a vertical bank of electrical resistance wires stretched horizontally across the airstream. The wires will be 0.010 inches in diameter spaced at 10 per inch. The electrical controls are being designed to control the temperature gradient to any desired value within the limitations of power supply. A maximum constant gradient of 6° per foot will be obtained at a wind speed of 8 ft. per second. In addition to temperature controls across the stream the temperatures of the top and bottom surfaces of the test section will be controlled. It is planned to control the initial velocity profile with a graduated screen placed vertically across the air-

stream near the heating section. Preliminary experiments utilizing the method described have shown promise of success.

A pilot wind tunnel has been built to evaluate and eliminate equipment difficulties in proposed design features before their construction in the larger tunnel. Part of the working section and all upstream units are reproduced to an approximately one-fifth scale in the pilot tunnel.

WITH THE cooperation of the Brookhaven National Laboratory, where extensive field studies on atmospheric characteristics and stack gas diffusion are being made, analysis of field data for wind tunnel purposes is now under way.

The initial program which enabled the Research Division to study gas dispersion problems associated with industrial installations has not only provided some useful practical information guiding particulars of building configuration, but has also provided information on certain disposal characteristics obtainable only with the closely controlled and correlated studies made possible by the development of the original wind tunnel with its observational and photographic facilities. Fundamental information obtained by using this tunnel has promoted more rapid progress on the meteorological wind tunnel developments now under way. Even though advancement toward the long range objective is slow, it is believed that the approaches discussed in this paper are sound, and that the promise of experimental work to date justifies an attitude of optimism with respect to future utilization of prototype models in wind tunnels as a means of obtaining data essential to the solution of many atmospheric pollution problems.

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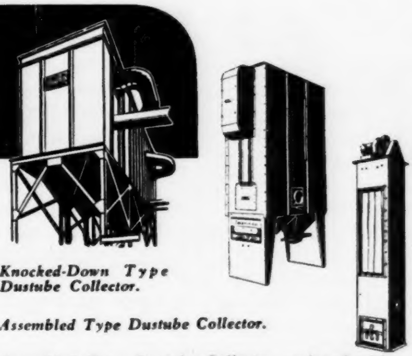

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Bethlehem Steel Company
Bethlehem, Pennsylvania

NO SIMILAR period since the birth of industrial hygiene, as we think of it today, was as fruitful or as fertile as that of the last two or three years. There has been notable progress in every aspect of the industrial hygiene field and several new activities have been added to broaden the scope encompassed by the term industrial hygiene. Progress in these newly-added segments has been even greater in most instances than in those which previously constituted this field. It is absurd to try to summarize even briefly all new developments that properly fall within the province of industrial hygiene in a short paper. Consequently, most new developments will merely be noted while a few of the more important ones will be summarized.

The different items to be covered herein may be subdivided into six groups as follows for the sake of clarity: (1) Toxicology, (2) Contaminant Control, (3) Hazard Evaluation, (4) Atmospheric Pollution, (5) Radiant Energy and Radon, and (6) Miscellaneous.

Toxicology

BERYLLIUM continues to engage the attention of many. The report of the Saranac Symposium on the beryllium problem became available and contains much useful information for those who encounter this metal or its compounds. Further studies on the epidemiology of beryllium poisoning begin to suggest possible answers to the unusual findings in this connection, as already noted by Sterner and Eisenbud.* Experimental evidence to indicate that beryllium can produce bone cancer adds another rivet to the whole structure of the beryllium story.

The importance of industrial carcinogens has received new and increasing attention.

Controls on the newer insecticides or economic poisons have been drawn tighter by the joint effort of several separate organizations. Notable advances in this respect are the appointment of a committee by the AMA Council of Industrial Health and the hearings conducted by the Food and Drug Administration over a period of several months with respect to the residue levels on fruits and vegetables. Here is a problem which begins in the chemical manufacturing industry, extends through the formulating, packaging, or distributing industry, to the farmer and then finally to the consumer. Industrial hygiene workers are in on the problem from the birth of the chemical to its death or final dissipation.

The newer equipment, techniques, and instruments available for studying particle size and other characteristics of atmospheric pollutants have given us a new insight into some of the many epidemiological problems that have remained without satisfactory explanation. This avenue of research and investigation is only in its beginning. However, it looks as if even the old standby, silicosis, is about to be exhumed and re-evaluated. In addition to particle size, the age of the silica dust appears to have an important influence on the degree of proliferation produced by silica in experimental animals.

A new trend was established with respect to maximum allowable concentrations. On the basis of the splendid work done by Sterner and his associates, the American Conference of Governmental Industrial Hygienists increased the MAC for butyl alcohol from 50 to 100 ppm. This represents a departure from the more common procedure of lowering the values when they appear to be high but not increasing any. It suggests to all workers in this field that

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Presented at the joint meeting of all participating Associations, 1951 Industrial Health Conference, Atlantic City, New Jersey, April 25, 1951.

*JAMES H. STERNER, M.D., MERRIL EISENBUD

it is just as important to gather data which tend to exonerate certain atmospheric contaminants as to incriminate them.

Industrial hygiene toxicology will be helped markedly in the future by the work in progress in the Food Protection Committee of the National Research Council. It is the aim of this committee to set uniform standards for studying and interpreting the toxicity of food additives for the protection of public health. The assistance this work will give to the many and varied research projects on toxicology being conducted by or for industry can easily be imagined.

Contaminant Control

CONTAMINANT control may be divided into two broad categories; namely, prevention of excessive contamination of the workroom atmosphere and prevention of the discharge of large quantities of contaminants to the outside air.

Among the first group, advances were made in precautionary labeling of toxic materials including the promulgation by the Illinois Industrial Commission of "Proposed rules and regulations relating to labeling in the use, handling, and storage of substances harmful to the health and safety of employees." The American Standards Association issued two new standards pertaining to the control of health hazards in welding operations and at all open-surface tank operations. The latter standard is a radical departure from most other similar publications of this or other organizations in that (1) it was developed to include a group of widely different operations but which are similar insofar as the control procedures are required, and (2) the ventilation rate required to accomplish satisfactory control is keyed to the two variables which govern the degree of health hazard associated with the operation. Publications of this kind as well as the Industrial Ventilation Manual prepared by the American Conference of Governmental Industrial Hygienists and issued about two months ago begin to take the engineering control of industrial atmospheric contamination out of the clouds and bring it down to earth so that plant engineers everywhere can design local exhaust systems that have a better than fair chance of working satisfactorily and efficiently. The conviction that industrial hygiene begins in the blue print stage of new building construction and new process or equipment installation is finally being accepted more commonly by industry and regulatory bodies alike.

In the other group, the establishment of the Air Cleaning Laboratory at Harvard is probably the most important step ever taken in the field of air cleaning and atmospheric pollution control. The findings from this research body will go far to remove the feeling of frustration from plant engineers and industrial management when faced with problems of atmospheric pollution abatement. The high efficiency filter paper developed by one consulting research organization for cleaning air with relatively low dust loadings is a most welcome development to all who are faced with the complete removal of very toxic or otherwise extremely objectionable particulate contaminants from the air discharged to the outside. The successful applicaiton of an electrostatic precipitator type collector to an open hearth stack was completed only recently.

Hazard Evaluation

HAZARD evaluation includes the sampling and analysis or direct measurement of air contaminants, noise, illumination, x-rays, gamma rays, radiant heat, etc., as well as biological sampling and breath sample collection and analysis. In this group the recent work by personnel of the AEC and to be discussed by Jetter and Harley* on breath radon sampling is important as is the large amount of experimental work done by the same organization on filter paper air sampling noted by Harris et al.** The use of the mass spectrometer in measuring quantitatively combinations of salts which defy evaluation by ordinary chemical methods was demonstrated by workers in industrial hygiene at the Eastman Kodak Company. Air sampling in out-of-the-way places by using a windmill as the motive power shows promise. If this proves completely satisfactory, it will be a most welcome tool

*EVELYN JETTER, JOHN H. HARLEY

**W. B. HARRIS, ALFRED J. BRESLIN, and PAUL B. KLEVIN

for air pollution sampling. The knowledge of the significance of coproporyphinuria in lead exposure was advanced considerably during the past year. Industrial hygiene workers were called upon by civil defense agencies to instruct their workers in radiation monitoring.

Atmospheric Pollution

LITTLE need be said about advances in this specialty. The newspapers and other popular news media have carried the story. Industrial hygiene personnel have taken expected interest and action in this work because the techniques and methodology of air sampling and analysis are quite similar irrespective of whether the sampling is done in a workroom, in a community, or in a stack. The A.S.T.M. established a committee on Methods of Atmospheric Sampling and Analysis. About 50% of the membership of this committee are AIHA members. If the committee attains its aims and objectives it will constitute a long step forward in the field because the results reported by different workers will be more meaningful. Air pollution control legislation reached new heights in recent months. Greater uniformity in this department is desired by everyone concerned. A course in atmospheric pollution was instituted in the engineering college of the University of California. Certainly the greatest need in air pollution at present is that of education —education at all levels, not alone in colleges.

Radiant Energy

THE CONTROL of radiant energy from radioactive materials advanced, including that at shoe-fitting machines. The AEC and its allied organizations continued to make news in the prevention of health hazards at operations which probably are potentially the most hazardous of all undertakings ever carried out in this or any other country. This is the best kind of evidence to indicate what can be done if the information at hand is put to work.

The control of radiant heat by radiation shielding is one of the most spectacular things ever done to my knowledge in the field of industrial hygiene. So much can frequently be accomplished by so little effort that it is hard to understand how it has gone unnoticed for so long, especially since the fundamentals involved are taught in high school physics. Credit in this regard should be given to Hatch, Hazard, and Dunn.* The application of shielding to reduce radiant heat rivals all other recent advances in the field of industrial hygiene.

Miscellaneous

INDUSTRIAL health has been advanced immeasurably in recent years by the service the industrial hygiene personnel of certain industries such as chemical and petroleum are providing to their customers. How many deaths and how much illness were prevented by this "stitch-in-time" philosophy can only be guessed at. The proposed uniform industrial hygiene code developed by the American Conference of Governmental Industrial Hygienists and currently under consideration by the American Standards Association can serve a very useful purpose if carefully drawn from both the legal and industrial hygiene viewpoints.

The foregoing should convince anyone that the industrial health progress made by industrial hygiene personnel in recent years is considerable. Lest anyone should gain the impression that all problems have been solved, I should like merely to mention a few of the pressing problems facing the industrial hygiene profession at present in addition to those alluded to previously. Examples are noise, and it should be spelled with capital letters; increased production of aromatic solvents; radioactive indicators and gages; new core binders and dryers in foundries; dust control at continuous mining equipment and at drilling operations for roof bolting in mines; dust or contaminant removal from the air or gases discharged through process equipment stacks and vents; carbon tetrachloride for miscellaneous degreasing, cleaning and fire extinguishing purposes; and high voltages used in industrial x-ray testing equipment.

*THEODORE F. HATCH, W. G. HAZARD, and KARL L. DUNN

New Developments in Industrial Health

Report for The American Conference of Governmental Industrial Hygienists

LESTER M. PETRIE, M.D., M.P.H., F.A.C.P.
Division of Industrial Hygiene
Georgia Department of Public Health
Atlanta, Georgia

REGARDLESS of our particular professional specialty, or whether we work directly in industry or are engaged in governmental activity, I believe that in recent years we have all recognized an increasing complexity in the field of industrial hygiene. Governmental personnel, in particular, have been caught up in a veritable maelstrom of activity, either directly related to, or associated with, the control and prevention of occupational disease. Nor can there be any slackening in these efforts. Potential hazards are inherent in the new substances and processes streaming from our dynamic American industry. In addition to routine activity, the industrial hygiene agencies have had to cope with new problems, such as air pollution, the increasing use of ionizing radiations, and the introduction of virulent insecticides. Briefly I should like to touch upon a few of these newer developments and to point out any discernible trends in governmental industrial hygiene.

Air Pollution

ALTHOUGH the problem, of course, is not new to the governmental industrial hygienist, the assumption of responsibility may be considered a new development. The emphasis placed on this activity has varied in the different state and local agencies. In some, as in the state of Pennsylvania, air pollution control has enjoyed divisional status. Several agencies have established their own mobile laboratories in order to facilitate their work in this field. On the whole, however, industrial hygiene agencies have fitted air pollution work into their operating pattern without the acquisition of additional apparatus or personnel. Projects that may be cited as outstanding illustrations include the steel industry study by the Cleveland Division of Air Pollution Control and the work of the West Virginia Industrial Hygiene Division in the Kanawha Valley. Of particular significance is the fact that the latter investigation is being supported in part by local industries in the area under study.

The increasing demands on industrial hygiene agencies for air pollution work have had their counterpart in growing legislative pressures. There has become apparent a decided trend to attempt to control air pollution through legislation.

In some states, the legislatures have established commissions to study the problem before enacting any restrictive measures. In Maryland and New Jersey, for example, the collection of such data is being undertaken by the industrial hygiene agencies for the commissions. Several other states have pending on their legislative docket bills of varying scope and severity.

Interest in air pollution control has also loomed on the international scene with the launching of a study at Detroit, Michigan and Windsor, Ontario, by the International Joint Commission. Technical personnel and funds for this investigation are being provided by *both the United States and Canadian Governments*. The Public Health Service in cooperation with the state and local health departments, and other groups, is taking an active part in the study and is directing work of the U.S. delegation.

The Public Health Service also participated in the study of the acute air pollution episodes in Poza Rica, Mexico, last year, in which 22 persons died and 320 were hospitalized, presumably from exposure to hydrogen sulfide gas.

From the standpoint of Federal responsibility for air pollution work, it may be of interest to note that a joint house resolution has been introduced authorizing studies by both the Public Health Service

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and the Bureau of Mines. Under this proposed legislation, the Bureau will concern itself chiefly with the conservation of substances now being discharged into the atmosphere, while the Public Health Service will study the physiological effects of air pollution on man. This is in line with a recent agreement between the two agencies spelling out related responsibilities.

Ionizing Radiation

ALTHOUGH here, too, governmental industrial hygienists have had previous experience, as in radium dial painting exposures, the newer applications presented problems for which they were but little prepared. To meet this need, the Division of Industrial Hygiene of the Public Health Service and other groups held numerous seminars to which the states sent selected personnel. Necessary equipment purchases were also made by the states. Thus, today, State agencies have at least one person with some specialized training as well as apparatus to cope with these problems.

Some of the studies made in the past year centered around the *industrial* use of x-rays, and the use of x-ray and fluoroscopic units in hospitals and health departments—not a new but an intensified problem. A comparatively new hazard under study was the use of radioactive static eliminators to prevent objectionable static electricity in high speed processes. Now under way in the Colorado Plateau is a study by the Public Health Service, in cooperation with the industrial hygiene agencies in the state of Colorado, New Mexico, and Utah, of the health hazards associated with the mining and milling of uranium.

Of broader public health implications was the widespread study of hazards arising from the use of fluoroscopic shoe-fitting machines. Systematic monitoring surveys of these machines were completed during 1949 and 1950 by 40 state and local agencies. Without exception, each agency reported that most of the machines in use were producing potentially harmful amounts of stray radiation, and that many were not being operated according to good practice. These surveys have already borne fruit, in that regulations governing the safe operation of the machines were adopted by local health departments in Detroit, Michigan; Milwaukee, Wisconsin; New York City; and Louisville—Jefferson County, Kentucky; and by the State Boards of Health in Indiana, Kansas, Mississippi, and West Virginia.

Economic Poisons

THE INCREASING use of *highly* toxic economic poisons—particularly parathion—has brought new occupational hazards to the farm. As you know, a number of deaths have occurred among farmers and airplane pilots spraying or dusting with these insecticides, as well as among industrial employees engaged in mixing and packaging operations. Illness has also been reported among persons living in contiguous areas who were exposed to large amounts of the spray or dust. To cope with this problem, the Public Health Service and several state agencies have been engaged in toxicological research, and a vigorous educational program has been under way to warn all users to observe necessary precautions.

Environmental Cancer

ENVIRONMENTAL CANCER is a comparatively new area which has elicited increasing activity. The National Cancer Institute of the Public Health Service has provided grants to several states for research activities in this field. Some of the states are studying vital statistics in an attempt to discover the relationship between cancer deaths and occupation, while others are approaching the problem through studies of cancer patients, investigations of the occupational aspects of lung cancer, and studies in industry. At present, several state agencies are participating with the Public Health Service in a study of the chromate manufacturing industry.

Mental Health in Industry

A LITTLE-EXPLORED area which has been gaining in prominence is the mental health problem in industry. The recommendation that a study of the actual situation be conducted was made a year ago at the first meeting of the National Advisory Committee, to the Public Health Service. At a recent meeting, the Committee expressed disappointment that such research had not been undertaken and re-

affirmed its stand in a second resolution. To implement this recommendation, consultations have been under way between the Division of Industrial Hygiene and the National Institute of Mental Health; and a meeting of a panel of university, industrial, and labor personnel was held in March, as the first step in this direction. We are hopeful that a practical research pattern will evolve from the efforts of this group.

Occupational Disease Reporting

IN THE CONTROL of new hazards, as well as the older forms of occupational illness, occupational disease reports can be a valid index of prevalence and severity. The lack of adequate and uniform reports, however, has constituted a serious setback to the industrial hygiene program. In an attempt to meet this deficiency, a two year pilot-study as the first step in determining the feasibility of developing a national reporting system has been launched. Ten states, each with various reporting practices, are participating in this project, and, to date, these agencies have transmitted 3,700 individual reports to the Division of Industrial Hygiene of the Public Health Service, which is serving as a central collecting agency.

It is hoped that this study will provide factual information for setting up much-needed criteria on reporting and diagnosing occupational diseases, and, to some extent, on prevalence statistics.

Local Participation

THERE is a marked trend throughout the country to better implement the overall industrial hygiene program through local participation. The local health department is being drawn closer and closer into active cooperation in studies and in the promotion of in-plant health services. In some instances, the State Industrial Hygiene Agencies have district offices housed in the local health departments, thereby facilitating cooperation. Twelve city and county health departments have their own industrial hygiene units, and the further establishment of such units is being encouraged by state agencies in areas where it is justified. Much good can accrue from this cooperation—not only in the performance of industrial health services, but also in the coordination of the program with community health facilities.

Activities of ACGIH

WHILE governmental industrial hygiene agencies are attempting to strengthen the industrial hygiene program through such administrative means and technical studies, the personnel of these agencies are also working collectively as members of the AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS. An objective of this organization is the exchange and coordination of the information and experience for the improvement of services to industry. Since the group is representative of personnel in federal, state, and local agencies, as well as some members from other American countries, it is in a good position to promote and develop standards of good practice in the field that are acceptable to all.

One example of ACGIH activity is the work of the Committee on Threshold Limits, which, each year, prepares a revised list of threshold limits to reflect the latest available data on the toxicity of air-borne contaminants. The list is now widely used as a guide in establishing allowable concentrations of toxic materials in industrial operations.

Another example is the work of the Committee on Industrial Hygiene Codes in developing a "Guide for Uniform Industrial Hygiene Codes or Regulations." The guide is being used by several industrial hygiene agencies and is also serving as the basis for the development of an American Standard on Industrial Hygiene by the American Standards Association.

The guide on dry cleaning regulations has recently been adopted by the Conference, and some of the other specific guides in various stages of completion include the one on fluoroscopic shoe-fitting devices and one on radio active static eliminators. When completed and approved, these standards will be available to official agencies for legal adoption or for use as guides in their work.

Another long-felt need has been met by the preparation of a good practice manual on ventilation by the Committee on Industrial Ventilation. This manual has recently been published and should prove an invaluable aid to industrial hygiene engi-

neers. A different type of handbook which should also find wide use among state and local industrial hygiene agencies, as well as other interested groups, is the manual of suggested record forms and procedures, which is now in process of completion by the Committee on Records and Reports.

These are but a few of the tangible results of the work of Conference members. Other equally important activities continue, such as the work of the Committee on Standard Methods in reviewing and testing methods for analysis of various air contaminants, and the efforts of other committees in the fields of Small Plants Health Services; Ionizing Radiations; air pollution; standardization of sampling instruments; and health information.

This summation of some of the newer activities—or at least new phases of old problems—that are confronting governmental industrial hygiene agencies only scratches the surface. One important fact that stands out, I believe, is that, although these agencies have been seriously hampered by staff limitations, they have managed to keep pace with many of the problems arising from new technical developments. Needless to say, a multitude of problems still lies unexplored. However, if acceptance of the challenges of the last few years is any criterion, these, too, I am confident, will be taken in stride, and we will maintain *healthy manpower* in America —*healthy* manpower for *maximum* production—to *preserve* our way of life.

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INDUSTRIAL HYGIENE PROBLEMS

Ventilation of Foundry Pit Furnaces

H. J. WEBER
American Brake Shoe Company
Chicago, Illinois

VENTILATION of the pit or floor furnaces shown in Fig. 1. presented many problems especially from the practical viewpoint.

Various types of bronzes containing up to 20% lead are made in these furnaces and high concentrations of lead oxide fumes are given off during the melting period. Workmen charging and removing the crucibles were exposed to unsafe concentrations of finely divided, (< ½ micron in diameter) freshly formed lead oxide.

Fig. 1.

It is impractical to use monorail cranes for removing the crucibles from the furnaces so that the more flexible conventional overhead crane is required. This fact and the need for great accessibility to all the furnaces precluded the possibility of installing exhaust hoods over this type of equipment. Furthermore, ambient temperatures in the vicinity of the work areas are about 125° F. No radiometer measurements were made but the radiant heat load imposed on the men is known from experience to be high.

Exhausted cover lids over the furnaces were tried out. (The exhaust duct connections to the covers can be seen in Fig. 1.) Intense temperatures warped the steel lids in a few days. Especially fabricated lids of refractive material, while capable of withstanding the high temperatures, were soon cracked and broken by shocks and impact with the grapple tongs used to remove the crucibles from the pits.

The following remedy which was finally adopted, proved to be an effective solution of the problem.

The floor directly in front of the furnaces was removed and an air tunnel installed. The tunnel was covered with a steel grating as shown in the figure. Baffle plates were suspended at experimental intervals below the grating to get an even distribution of air.

A fan capable of delivering 25,000 C.F.M. was installed at the far end of the tunnel. This fan brought in fresh outside air and delivered it uniformly through the interstices of the grating. This formed in effect an air curtain at the breathing zone of the workmen and effectively diluted the fumes to safe concentrations. Overhead ventilators removed the contaminant from the building.

The observed effects were:

1. The fume was blown away from the men and upward. This can be seen to a small degree in the figure by observing the slight deflection of the flames toward the wall.

2. The cooling effect of the cold air on the men made the atmosphere more comfortable. Workers were very pleased with

[EDITOR'S NOTE: Practical solutions of interesting problems are invited. These may be simple helpful hints to others or extensive solutions of complicated engineering problems.]

the results accomplished by this installation.

3. The installation introduced no heating problem since the overhead ventilators did not remove intentionally heated air but cold outside air.

4. The system offered absolutely no interference with operations, with the overhead cranes, or production.

Air samples were collected along the floor grating at the breathing level of the workmen, with the air curtain turned off and with it in operation. The samples were collected at the foreground end, the center, and the background end of the grating. The results are given in the following table:

TABLE I.

Location of Sample Station	Atmospheric Concentration of Lead Oxide MG/10 Cu. M. Air Off	Air On	Percentage Reduction in Lead Concentration
Foreground end	5.5	1.7	69.0
Center	7 5	0.7	90.0
Background end	5.1	0.6	88.0
Average	6.0	1.0	83.0

The results obtained so far indicate that a favorable solution of the problem has been found.

Midwest Safety Conference

THE MIDWEST Safety Show and Civil Defense Conference was held at the Congress Hotel, Chicago, Illinois, June 4-7, 1951. Industrial hygienists in the Midwest contributed to the conference by participating in the Industrial Hygiene, Industrial Nursing, and Radiation Detection Section programs. This year's conference emphasized industrial civil defense by devoting a full day to these problems. The speakers for this program consisting of industrialists and civil defense officials, outlined the problems and responsibilities of industry in Chicago's civil defense plan. This plan is reviewed in detail in the publication *Chicago Alerts* which is available from the Director of Chicago's Civil Defense program at $2.50. The industrial hygiene section program included three papers. The first was a discussion of the Illinois Labelling Law by ARVID TIENSON. Actually, this is a code promulgated by the Illinois Labor Department and is intended to regulate the labeling of toxic, flammable and dangerous chemicals. The code classifies chemicals into various groups and specifies types of labels for each class. The code provides that ingredients of hazardous trade name chemicals must be included on the label, but it is not necessary to record exact percentages of ingredients. The code has no jurisdiction over suppliers of chemicals from outside the state of Illinois. However, state distributors of those chemicals must comply with the code. GORDON HARROLD presented a paper on "The Correlation Between Industrial Hygiene, Safety and Industrial Nursing." RICHARD MYLES discussed "An Industrial Hygiene Program for the Small Plant." This was a report of the function of the safety engineer and others in the control of occupational diseases in small plants. A practical industrial hygiene program for small plants was presented. One session of the conference was devoted to radiation detection in atomic warfare. This included discussions of "Radiation Problems in Atomic Warfare" by KENNETH M. MORSE; "Radiation Detection Instruments" by HAROLD MAY; and "Radiation Detection Problems in Atomic Warfare" by DR. RICHARD J. HUMPHREYS. Members of AIHA and the Chicago Section were active in other section programs as panel participants.

Industrial Hygiene in West Germany

LUDWIG TELEKY, M.D.
New York City

THE SCIENCE of occupational disease prevention and industrial hygiene has a long history in Germany. In 1723 Johannes Bubbe wrote about the disease of quarrymen and in 1728 Wepfer wrote on the same subject; in 1780 J. Ch. Gottlieb Ackermann published a new and enlarged edition of B. Ramazzini's "Diseases of Artisans"; it was three times the size of the original book and much improved, especially in its treatment of occupational hygiene. In 1871-1878 L. Hirt published "The Diseases of the Worker" in four volumes; in 1898 Th. Sommerfeld's "Handbook of Occupational Diseases" appeared. In the principality of Lippe a regulation was issued in 1824 with intent to reduce the dangers to which the quarrier was exposed. In 1842 Prussia adopted a rule to help prevent lead poisoning among workers in porcelain factories. In 1869 the North German Confederation passed a Trade Law, which was extended to all of Germany in 1873. Section 7 of this law prescribes labor conditions for workshops and factories. The 1869 Trade Law sets forth approximately the same requirements as those contained in paragraph 120, later 120a, of the subsequent laws, which have not been changed.

The law demands that every employer make his workshop or factory as safe and healthful as possible. The authorities have the right to make rules for certain types of plants, which rules the employer (and the worker) must obey. Where such regulations have not been made, however, the employer is still bound by law to make his plant as safe and healthful as possible.

At the beginning of the Second World War 33 such regulations, issued by the Bundesrat or the Reichsarbeitsminister, were in force. In addition, a book published by the "Deutsche Gesellschaft für Gewerbehygiene" ("German Society for Industrial Hygiene") enumerates 863 regulations imposed by State governments, cities, and police departments on special industries, most of these rules affecting only small districts.

IT SHOULD also be mentioned that the regulation, edited by the Bundesrat, March 11, 1892, affecting young people employed in glass factories was the first rule requiring *pre-examination* by a physician approved for this purpose by the authorities. Similar regulations, dating from August 8, 1893, concerning phosphorus match, and lead paint factories were the first to prescribe periodic examinations of workers by a physician. Such rules are now many.

But what measures are taken for the enforcement of the law and the rules? Paragraph 139b of the Trade Law reads: "The supervision of the performance of paragraph 120a shall be exclusively, in addition to police authority the function of special officials appointed by the government of the State. Said special officials shall exercise all the powers of the local police in performing their supervisory functions, especially the right to inspect plants at any time. They shall treat as confidential all information concerning any peculiarities of a business or plant, that come to their official knowledge,* except that they shall give notice of all violations of the law."

These "special officials" were the *factory inspectors*, who were under the Ministry of Trade and Commerce (as was all trade legislation) and, after the First World War, under the Ministry of Labor.

According to the regulation for their service ~~the~~ factory inspectors must see to it that the Trade Law and the various regulations are carried out. Paragraph 6: "Their principal function shall be to raise the level of factory and working conditions to a satisfactory standard by rendering expert advice and mediatorial assistance based on their knowledge of the governmental regulations, on their

[Editor's Note: See Archives of Industrial Hygiene and Occupational Medicine, Volume 3, Number 3, March, 1951: "A Report on Industrial Hygiene in the Western Zone of Germany" by Irving R. Tabershaw, M.D., pages 298-315.]

*Therefore scientific publications never mention the name of the firms or give dates, which make it possible to recognize them, and they do not unveil secrets of production.

technical knowledge, and on their experience." Further, whenever a new plant is to be built or alterations in an old one made and said plant requires a license (as do all plants which may prove dangerous or disagreeable to its neighbors or dangerous to its workers), the factory inspectors are to cooperate with the other officials for the purpose of determining what requirements shall be fulfilled before a license is granted.

If he is to perform these tasks properly, the official must be *thoroughly trained* and prepared; he must have full and complete knowledge of his field. The required training includes: completion of an engineering or chemical course of study at a university or equivalent institution; one and a half years of legal study, especially of labor laws, at a university; one and a half years of practical work in the office of a factory inspector. The candidate must then take an examination; if he passes he is appointed as an assessor and works with an inspector until he is promoted to that position himself. As an inspector he is a governmental employee with the rising salary of a higher official; his appointment is for life. He receives a pension; when he has served for 30 years, he is entitled to a pension equal to the salary he was receiving on the date of his retirement. And, what is extremely important for a factory inspector, *he cannot be dismissed* except for a criminal offense or a near-criminal offense, as determined by a court composed of his colleagues, lower and higher government employees.

In 1940 there were 449 such inspectors and assessors in Prussia, about 750 in Germany.

Here are a few facts: During the year 1935, the inspectors in Germany, besides visiting factories and workshops, rendered 2230 expert opinions concerning the construction of new factories. In the one district of Breslau they gave their expert assistance to the authorities in 633 cases. Let me stress again that their function goes far beyond the enforcement of certain rules and regulations. They have to see that the Trade Law (Paragraph 120a) is accomplished; that every factory is rendered as safe as possible; they have to give factory managers the benefit of their knowledge and experience. It would be quite wrong to imagine that they do "not offer any technical assistance but act essentially as policemen with engineering degrees."

In the interest of accuracy it should be added that the factory inspector does not design exhaust installations or other equipment for health and safety. The law and common sense both dictate that the management render the factory as safe and healthful as possible; that is as much the duty of the management as is efficient operation. The factory inspector simply gives advice and expert opinion as to how safety and healthfulness can best be achieved.

The German factory inspectors receive much the same training and perform much the same tasks as the English, whose Chief Inspector has described them as 'friendly advisers, whose advice is backed by the knowledge that they have the power to enforce their recommendations." The German inspectors, like the English must make annual reports on their activities; the whole or excerpts of these reports are laid before the German parliament. Formerly they comprised three or four volumes; even under Hitler when everything not pertaining to war was pushed into the background, the 1935 and 1936 reports contained altogether 1500 pages.

Since the German Republic is just now undergoing reorganization, factory reports have not recently appeared, but that for 1950 is now in preparation.

The reports of former years—like those in other European countries—are veritable storehouses of observation, experience, descriptions of useful new safety devices, etc., and proposals. Unfortunately these reports, although made easily available by the booksellers, have not received the attention they merit from the profession.

A system analogous to factory inspection also exists *for the mines*, adapted to the peculiarities of the mining industry and therefore, in some respects, more comprehensive. The duty of the "mine police" ("Bergpolizei") all over Germany is to see that the mines are in good condition, that the lives and health of the miners are protected, that the surface of the earth is not unduly damaged, and that the community is not dangerously affected by the operation of the mines. There were in Prussia 546 mine inspectors, all well trained mining

engineers. Their annual reports have been published together with those of the factory inspectors. Thus "Bergpolizei," the mine inspectors, work today in the whole of West Germany, including the Ruhr district, as they did before.

The Prussian Ministry of Trades created in 1922 in its Department of Mines a special "Grubensicherheitsamt" (Office for the Safety of Mines) for the purpose of studying all the questions of accidents and health in mines, and of conducting research for improvement of the conditions. This office has done a great deal of research work and experiments.

The Reich, Prussia, and the Mine Insurance Association together ran in the Ruhr district an experimental mine for testing new safety devices. Now the successor of the Prussian Office is the "Division of Mines Safety and Mine Police in the Ministry of Economy ("Bundeswirtschafts-Ministerium.") There exist also experimental mines (Versuchsstrecken").

THE *insurance of workers against accident* and occupational disease in Germany is handled exclusively by the "Berufsgenossenschaften" ("Trade Insurance Association"), compulsory organizations of all employers in each particular industry. The mines are included in this setup. The insurance associations are organized in accordance with strict rules laid down by the workers' insurance laws; they are non-profit organizations and must follow all legal regulations under the careful supervision of the "Reichsversicherungsamt" (National Insurance Office). The premiums are paid by the employers; rates are fixed according to the danger class in which the work belongs, i.e. the degree and type of danger involved in the work (Paragraph 706). These "danger rates" must be re-checked at intervals and must be approved by the Reichsversicherungsamt (Paragraph 709). The statute permits extra charges or reductions to employers, according to the rate of accidents in their plants.

In addition to the insurance of workers against accidents (including certain occupational diseases) these "Berufsgenossenschaften" have other functions. Paragraph 848: The Berufsgenossenschaften shall see to it that accidents are prevented and that persons injured in accidents receive effective first aid as far as possible in accordance with the advancement of technology and medicine and the economic efficiency."

The trade associations are also requested (Paragraph 875) to "*employ technical inspectors* in sufficient numbers to supervise the observance of the regulations and to take cognizance of factory equipment and installations insofar as necessary for the question whether the employer is a member of the association and the assessments of risks." The appointments must be approved by the Reichsversicherungsamt (National Insurance Office).

These technical inspectors must cooperate with the factory and mine inspectors and vice versa, each bearing in mind the regulations published by the other.

The Trade Insurance Associations also established a union which created a "Central Safety Office" (formerly at Berlin, now at Bonn). This agency put out a large number of posters instructing the workers how to avoid dangers of various kinds. Several associations offered premiums to employers and employees with fine accident prevention records.

Thus we find a tremendous number of rules, regulations, and procedures for health protection issued both from the authorities and the insurance associations, with a host of supervisors, well trained for their job, seeing to it that the rules are observed and that the plants are as safe and hygienic as possible. The destruction of the Reich *has changed almost nothing* in all these laws, rules, and regulations or in the position, functions, and powers of the supervising officials.

WITH the advancement of industrial hygiene, the cooperation of physicians became more urgent. Up to the beginning of World War II Prussia increased the number of her medical factory inspectors to eight, each of them aided by one assistant.

Under the decree of the Prussian ministry, the medical factory inspectors were appointed "to assist the technical factory and mine inspectors in handling questions of industrial hygiene." "They have the powers of governmental factory inspectors, particularly that of entering any plant at

any time without prior notice...." The medical inspectors also have the right—as have the other factory inspectors—to speak with any workers in the factory, and to make brief physical examinations. But they do not have the right to give police orders or fines; this is the prerogative of the local factory inspectors, who have authority over much smaller districts. One medical inspector's district includes the districts of about 10 to 20 technical inspectors. The medical factory inspectors are also entitled to give authorization to all physicians who have to make examinations of workers in a factory under any regulation whatever and not only according to certain particular rules.

It should be added that these inspectors were required to hold consultation hours, which they all did. These consultations were attended by sick workers, members of the workers committees and employers.

The regulations in force today in the other German States are similar.

The provisions quoted above concerning the functions of the medical factory inspectors clearly indicate that these inspectors are not occupied exclusively with industrial diseases. But the "sick funds" were required, from the beginning, to refer every case of occupational disease to them. In 1925 compulsory accident insurance was extended to cover certain occupational diseases. The employer has to report every accident resulting in death or disability of more than three days. In the same way the employer must report every case of occupational disease. In addition, any physician treating a patient with symptoms giving clear grounds for suspicion of the presence of a certain occupational disease (listed in the regulation) must refer it immediately to the insurer or the medical factory inspector. The medical factory inspector may either be present when the insurer is making his investigations or the findings must all be reported to him. Since 1937 the medical inspector has been required to examine the patient at once or to have him examined by another physician. The newest regulation facilitated this task by permitting omission of the examination when it seems unnecessary. This increased work resulting from the 1937 regulation, however, has been balanced by an increase in the number of inspectors and assistants.

The Bundesrepublik increased even more the number of offices of medical inspectors. In 1949 the visits to factories numbered 109 in Bavaria, 129 in Sud-Baden, 170 in Wurttemberg Baden, 104 in Schleswig Holstein. In 1950, 523 visits were made in the district of Dusseldorf.

The reports (the last of the year 1936) plainly indicate that they regard their task as reaching far beyond the control of occupational diseases. Some of the chapters treat of: general factory hygiene; workrooms (quality of air, ventilation, heat, cleaning, fume dispersion, etc.); work seats and tables; lighting, speed of work; psychic and somatic factors; sources of dust and its removal; fire prevention equipment; welfare rooms, etc.

The medical factory inspector visits factories without any special purpose in mind —sometimes to observe a certain kind of production, especially if it involves the handling or generation of injurious substances. Very often one of the above mentioned reports on occupational disease prompts him to visit a certain plant; it is his duty to find out the cause of the illness reported and to give advice on how to avoid further casualties.

What is his equipment for this task? He has the necessary equipment for routine clinical examination, including urine and blood analysis.

But sometimes a more thorough examination is needed, or examination by a specialist. The medical inspectors are connected with hospital staffs which either examine the patients or if necessary, admit them to the wards; or else the inspectors apply to qualified specialists with whom they work. Since no medical inspector can be a specialist in all fields, cooperation with university clinics, large hospitals, and individual specialists will always be necessary.

The sampling and examination of air impurities present greater difficulties because special instruments are needed for sampling and, under certain circumstances, special laboratory work is required. Special equipment is also necessary for the examining of particles of matter, solvents, or the like. The examination of dust requires special equipment. It may be true that

there are no "midget impingers" in the offices of some medical inspectors; but I know that the very useful Owens dust counter was used as early as 25 years ago and that the Tyndallometer, the Konimeter, and the instrument of Zeiss, have been widely used for the last 15 to 20 years, especially in mines. Nearly every Medical Inspector of Factories has an instrument for dust counting.

As to the detection and measurement of gases, it must be kept in mind that the most modern methods and the new American instruments have been used in the last 15 years, during which time Germany was cut off by Hitler and the war from the rest of the world. Further, these instruments are very expensive in German money. But instruments for measuring the carbon monoxide content of the air were constructed in Germany some 15 years ago and have been in use ever since. As long as 25 years ago German medical inspectors used the original method of Pertusi-Gastaldi for detecting and measuring hydrocyanic acid near hardening pots and plating tanks. E. Lederer describes in the "Methoden der Arbeitsmedicin," 1932, German apparatus for detection and measurement of different gases: Benzol, carbon dioxide and others. H. H. Weber, of the Reichsgesundheitsamt (National Department of Health), described, at a meeting of factory inspectors, and published in the "Zentralblatt für Gewerbehygiene" 23, 177 (1936), methods of detecting and determining the approximate quantities of several poisonous gases (hydrocyanic acid, arseniureted hydrogen, aniline, chlorine and others), chiefly by filter paper impregnated with certain substances.

Of course we must keep in mind that what we get from such sample examinations is a snapshot result depending also on voluntarily or involuntarily created circumstances. It is obvious that these methods—especially those requiring a laboratory—are to be used only when we know or suspect that there may be poisonous gases present, and even when we have such suspicions, it is almost impossible to examine every work place in a large plant. The reports received by the medical inspector on every case of occupational disease are a great help in indicating danger points.

Periodic examination by skilled and conscientious physicians not only saves the men, for example, from lead poisoning by revealing which of them has a higher degree of absorption, but thereby also discloses the hazardous operations.

But whatever the problems presented by the individual case, it is clear that laboratory work and sometimes even animal experiments are necessary for proper factory inspection, especially medical factory inspection.

As to examination of samples of certain materials, until World War II this was done for the Prussian medical inspectors by the "Research Institute for Food and Drugs" in Berlin (and by similar institutes in the other states). The Prussian institute still exists, under another name, in Berlin-Charlottenburg, but I doubt that it is able to work for Western Germany under present circumstances. There are now, as before, for certain simpler purposes the "medical research laboratories" of the various cities and districts and, above all, the chemical and hygienic laboratories of the universities, which have always cooperated well.

Thus the medical inspector has at his command various methods of air examination, his own knowledge of the methods employed in many industries, the facts given him by the workers committees, and the reports made by the physicians who give the workers periodic examination or treatment. The medical inspector does not find it at all necessary to rely on the statements made to him by plant managers.

It seems to me that such a combination of methods—air examination, periodic physical examination, with the physician required to report all cases of poisoning to the medical inspector—should give the best results.

TODAY the university institutes are also most helpful in this work, especially where more complicated and difficult research is necessary. Occasionally private laboratories also lend their assistance.

But although laboratory aid of various kinds is available there exists also well equipped laboratories in two offices of Medical Inspectors.

The institute of Professor Koelsch, in

Munich, carried on its work for decades; after the war it was rebuilt and given a large x-ray apparatus, two big laboratories with a staff of chemists, a sickroom with four beds, and a library.

Then there is the institute of Professor Nuck, in Hanover, which was built up during the last few years and has been developing well despite all obstacles.

The medical factory inspectors demanded at their first postwar convention (October 3, 1946) that every German state establish a medical factory inspection service center, an institute well equipped with personnel, up-to-date instruments, and medical literature, an institute insofar as possible connected with a university.

As to the medical inspectors' supply of professional books and journals, before the war they received an annual allowance from the Ministry for the purpose of buying such literature and other similar necessities. The sum they received was ample for the purchase of such material and even for additional minor research; for research on a larger scale the Ministry always gave special funds. During the war the offices of several medical factory inspectors were destroyed by bombs and plundering, so that a great many books were lost. German university and institute libraries lost in all about 10 million volumes; the universities of Wurzburg and Heidelberg together lost half a million, the university of Hamburg even more. The institute of Koelsch lost a large part of its library. The losses are being made good, but slowly and against great odds. Some German books, however, are no longer available at all; it is difficult to get foreign books and journals into Germany and, because of the low value of the Deutsche Mark, their cost is sometimes out of all proportion. But gradually the lost volumes are being replaced.

THERE were *factory physicians* in individual plants in the chemical industry even at the end of the last century. The National Socialists promoted this institution and wanted to enforce it by law, but the workers put up strong opposition. On July 26, 1950, the Ministry of Labor made public an agreement between the manufacturers' association, the unions, and the association of factory physicians concerning the service of factory physicians: "The factory physician shall be appointed or dismissed by the management in agreement with the workers committee (which is elected by the workers of the factory) after the opinion of the governmental medical inspector of factories has been delivered." His function is to "advise the management and the workers committee on all pertinent questions and to look after the well-being of the worker in his work and to give first aid in the factory."

The agreement will make it possible to collect some data about the worth of the plant physicians, whom many workers and unions deeply distrust even today. There is now an association of plant physicians.

AS TO the *role of the workers* and their unions in industrial hygiene, let it be noted that they have for decades been giving the most careful attention to its problems.

The chemical workers' union published a 123 page book in 1911, written by one of its leaders: "The Dangers of Work in the Chemical Industry."

Perhaps most revealing is the fact that when the German Association for Industrial Hygiene struck a medal bearing the name of its president, A. Weinberg, a big industrialist to be awarded for distinguished work in industrial hygiene, one of the six who first received the award (along with high government officials and scientists) was G. Haupt, a former worker who carried on industrial hygienic research in the chemical workers' union.

As early as 1911 the union of chemical workers made the assertion that there is occupational lung carcinoma among chromate workers. This was recognized by physicians and scientists only in 1936.

In pre-Nazi days the trade unions (there were two kinds, socialistic and Catholic) used to give courses for the members of the workers' committees to fit them for their duties. These courses always included lectures on industrial hygiene, given mostly by medical factory inspectors.

The law requires that the insured workers participate in the drafting of the "Berufsgenossenschaft"—rules for prevention of accidents and occupational disease; it is also required that at least one representative

of the insured workers has a vote in determining the final amount of the compensations.

This seems to me *the best education* for workers in industrial hygiene: to make many of them participate in responsible positions. That is much more efficient than "education" by paperwork.

The Union of the Trade Insurance Associations have published numerous colored posters explaining the importance of protective measures and how such measures should be taken in certain situations. Several insurance associations have published series of pictures for their own industries—The Association for Deep Level Work, for instance.

The instructions given to the medical factory inspectors include the requirement that they give enlightening lectures to promote understanding of the problems of industrial hygiene.

There are no statistics on this work, but it is fair to note that both the insurance association inspectors and other factory inspectors give such lectures free of charge. A report of the Society of Technical Inspectors of the Berufsgenossenschaften states that between November, 1947 and June, 1949 more than 75 lectures were given to over 10,000 listeners in 25 industrial centers.

Chiefly for use in such lectures, Koelsch has a big collection of lantern slides and another is now in preparation in North Germany.

What has been said regarding the activities of unions and workers committees should make it likewise impossible to believe that there is "no teaching that he (the worker) has a right to be protected against illness . . . . and that proved methods, including engineering techniques, are available."

ON THE subject of *scientific work,* let us refer first to that done by others than the factory inspectors.

Until the end of the war the German Health Department ("Reichsgesundheitsamt") had a "Division of Industrial Hygiene." It did much valuable research, mostly on occupational poisons (lead, chromium, mercury), and also on Ankylostomiasis, and the analysis of solvents. Between 1889 and 1938 the division published 45 articles on research work of various kinds. In May, 1945, the Geman Health Institute was closed and is now transformed into a "Bundesgesundheitsamt" to be located at Bonn. It is to be expected that this office also will have a division of industrial hygiene.

But in Germany the scientific centers are chiefly the universities, all of them financed exclusively by the state. In his Hygienic Institue at the University of Würzburg, K. B. Lehmann was the first man to study industrial hygienic problems by animal experiments, which he commenced in 1886. F. Flury worked at the same university in pharmacology and toxicology; his "Noxious Vapors, Gases, Mists, Fumes and Dusts" (written together with F. Zernik), published in 1931, offered the industrial hygienist an enormous wealth of facts and information. Unfortunately the second edition, prepared during the war, could not be published.

Industrial hygienic questions have also been treated in many other universities. There is now an "Institute for Dust-lung Research and Industrial Hygiene" connected with the Hygienic Institute of the University of Muenster.

Other existing institutes are: The Institute for the Physiology of Labor ("Arbeitsphysiologie"), Dortmund, which publishes a journal "Arbeitsphysiologie"; an Institute for Research on Dust, of the Trade-insurance-associations, formerly in Berlin, now in Bonn; and an Institute for Research on Dust of the Mine-insurance-association.

Among the research institutes should, of course, be numbered the above-described Institute for Labor Medicine of the Bavarian medical factory inspector, Professor Koelsch.

There is also the newly established Institute of Nuck, Medical Inspector of factories in Hanover.

Further, Professor E. W. Baader has his hospital department for occupational diseases. He started the first in 1925 in Berlin; it was soon used by the social insurance organizations, especially the trade accident insurance, for treatment and expert opinions. In eight and a half years this department handled 2,000 cases of chronic lead poisoning, 100 of chronic mercury

poisoning. The trade insurance associations sent him *all* their manganese poisoning cases. At the beginning of the thirties the hospital department was transferred, much enlarged, to the City Hospital in Berlin-Neu Kölln and declared a university institute. E. W. Baader is now head of a hospital of the miners' association in Hamm/Westfalen which has a department for occupational diseases. In the last few years also he has published many important works.

But the largest amount of research work, especially that connected closely with practice, and the greatest number of reports and publications on new dangers and new methods of avoiding them, must be credited to the factory inspectors, particularly the medical factory inspectors. A glance at the "Zentralblatt für Gewerbehygiene" and the "Archiv für Gewerbepathologie" will suffice to establish this fact.

As to the teaching of students and physicians and public lectures on occupational hygiene and disease: The first is treated in university lectures concerning hygiene, the latter in the clinics when there is material. Several universities and technical schools (of university level) have special colleges for industrial hygiene. During the last few years before 1939, attendance of college courses on labor medicine was compulsory and the medical student had to pass an examination on the subject before he could obtain his doctor's license. The necessities of war forced this requirement to be dropped and it has not been re-imposed as yet, but in various universities lectures are held mostly by the medical inspectors of factories.

As to post-graduate training, there are now two "Staatsmedizinische Academien," one in Düsseldorf and one in Hamburg, for the instruction of future health officers. At both of these institutions lectures are given on industrial hygiene and occupational disease, and the students visit factories as part of the course. Certainly health officers need a more thorough knowledge of this field than do medical practitioners; but in an industrialized country—which most of Western Germany is—even the practicing physician has need of some knowledge of the principles of industrial hygiene, especially occupational disease. It is therefore to be hoped that success will soon reward those who are now energetically endeavoring to make courses on the subject compulsory for medical students and to include industrial hygiene in the doctor's examination, so that the pre-war standard may once more be attained.

It was always recognized in Germany that knowledge of industrial hygiene must be disseminated more widely among employers, governmental and other officials, physicians, and engineers. Much good work was done in this direction.

As to newer books and journals, from 1935 to 1937 Koelsch published a big "Handbook of Occupational Diseases," 1178 pages. Most of it was written by Koelsch himself; but the section "Pathology and Hygiene of the most Important Trades" was written by several other medical factory inspectors.

In 1937 Koelsch published a "Textbook of Industrial Hygiene," a volume of 330 pages. In the same year volume 29 of "Work and Health," came out, edited by the Labor Ministry, by way of explanation of the third regulation on occupational disease insurance procedure. This is a book of 514 pages; part of it dealing with the single occupational diseases (296 pages) and is written by M. Bauer, H. Engel and Fr. Koelsch. In 1945 and 1947 Koelsch published a "Textbook of Labor Hygiene" in two volumes, totalling 850 pages. A smaller book, also excellent, was published in 1949, "Outlines of Labor Medicine" ("Grundriss der Arbeitsmedizin"), 324 pages, by E. Holstein, formerly medical factory inspector, now head of the Division of Labor Protection in the Eastern Zone.

All these books are excellent summaries of the knowledge we have gained to date in the field of industrial hygiene, written by real experts. They do not contain new discoveries or inventions of the authors—handbooks and textbooks never do. New ideas and deductions must be looked for in the professional journals. Unfortunately these journals suffered terribly by the war and its consequences.

Before the war the "Zentralblatt für Gewerbehygiene und Unfallverhütung" was published monthly by the "German Association for Industrial Hygiene." It offered a large number of articles, shorter but

most illuminating, on both technical and medical matters. It also printed numerous "Beihefte" and "Schriften" (booklets treating certain problems). There was for larger publications the "Archiv für Gewerbepathologie und Gewerbehygiene" ("Archive of Industrial Pathology and Industrial Hygiene"); also "Staub" ("Dust"), edited by the Union of the Trade Insurance Associations, and the "Arbeitsschutz" ("Labor Protection"), part of the "Reichsarbeitsblatt," published monthly by the Ministry of Labor, with special booklets treating different questions. And finally, there was the collection of monographs, "Arbeitsmedizin."

All of this had to be discontinued during the war—not, to be sure, because of lack of interest on the part of industrial hygienists. Nor is lack of interest responsible for the delay in the revival of these publications. The trouble is that the publishers are in a very difficult position: paper is scarce; printing offices have been destroyed; and all sorts of restrictions hamper the industry, to say nothing of financial difficulties. In a word, the war, the destruction, the occupation have all made the work of the publishers very difficult. Authors have therefore been forced to send their articles on industrial hygiene to the weekly medical journals, which have printed several such papers, and to the editors of former industrial hygiene publications, in whose desks the articles lie quietly. But a new dawn is breaking. The journal "Staub," and a "Neues Zentralblatt" have just put out their first new issues as has also "Berufsgenossenschaft" with the supplement "Unfallverhütung" (accident prevention). We have hopes that the other journals will soon follow.

During the blank years, however, the factory inspectors, technical as well as medical, found a way to make public at least some of their findings and discoveries.

I have on my desk The Yearbook of 1949, published by the Society of German Inspector-Engineers. This is a technical scientific society which works for the prevention of industrial accidents; it was founded in 1894 by the inspectors of the Trade Insurance Association. The book—120 printed pages in large format—contains the report on the annual meeting of 1949, with 11 lectures, delivered mostly by engineers on safety problems and devices, and five lectures delivered by physicians.

Also on my desk are three reports of meetings held by medical factory inspectors every half year, each with a rich scientific program. Let me emphasize that these reports are not semi-popular lectures, talking over facts already well known. They are—except for a few on organizational questions—reports on new organizations or new research work.

The medical factory inspectors express in these reports the hope that they will be able to print the reports of future meetings.

As to statistics of industrial accident and occupational disease, it is difficult to compare the American and German figures because the sources are so different. In Germany the "Berufsgenossenschaften" have to give precise data to the government; in the United States the government as well as the National Safety Council collect their information from voluntary reports of a limited number of plants, and it is probable that those with the worst records do not send in reports. Only "Accident Facts," published by the National Safety Council, gives us accident rates for the whole country covering the last few years. It tells us that fewer companies report to them than to the U.S. Bureau of Labor Statistics and that those firms which do report to the National Safety Council give lower accident figures than those which report to the U.S. Bureau of Labor Statistics. Thus the figure of 26 fatal accidents per 100,000 workers given in the National Safety Council booklet is almost certainly too low.

I have before me also the "Report on the Business and Financial Status of the Industrial Trade Insurance Associations for the Year 1949—edited by the Union of these Trade Insurance Associations at Bonn." In 1949 these associations had 9,940,000 insured workers. These insurance associations expended a total of 352,400,000 DM, of which 303,000,000 went for compensation (including medical treatment) and 9,800,000 (2.8%) for accident and occupational disease preven-

tion. This 9,800,000 DM was "for the most part spent on supervision of accident (and disease) prevention. The cost of ensuring safety in any particular plant must be borne by the employer"—as I have explained before.

A fact which may be of interest is that 8.66% of the total spent by all the other trade insurance associations went for occupational disease compensation—while in the mining industry 49% went for silicosis!

A few years ago I tried to compare the United States figures with the German; insofar as I could compare them at all, I came to the conclusion that the German figures for 1939 were lower than the American for 1944. Later figures for Germany were not available at that time.

In 1946 a well-known German medical inspector wrote me: "It is frightening to see under what hygienic conditions work is being done today. You cannot imagine what damage has been done to some of the factories. In many cases the hygienic installations are almost entirely destroyed .... Everywhere you find lower production, inadequate hygienic precautions." Later I received letters about the amazing job of rebuilding and repairing going forward in Germany—but of course hygienic measures and protective installations could not be expected to return at once to their prewar standard.

We may fairly say that the war and postwar conditions are responsible for the loss of a number of important aids to the maintenance of a high industrial hygienic standard in Germany, especially the installations in factories and the scientific journals. But the foundation is there; the organization of technical and medical factory inspection and mine inspection remains unchanged. The leaders are still alive and active: they are all working hard to rebuild what has been destroyed and to make further progress.

Basic Radiological Health Course

THE TEXAS State Department of Health announces a specialized civilian defense short course covering radiological health problems and designed to indoctrinate supervisory personnel and local instructors with the essentials of radiological defense and to enable them to conduct educational and training programs in radiological monitoring within their own geographical area, industry or department. The first course will be offered June 11-15, 1951; the second, July 9-14, 1951; and the third, August 13-18, 1951. The program is open to supervisory or professional personnel of local health departments, representatives of counties or cities where radiological defense is not vested in local health department, representatives of State Departments engaged in Civilian Defense, fire or police training officers or instructors, or members of industrial medical or safety departments contemplating an in-plant program. The program covers a week period of basic theory of radiation and radiation detecting instruments, the use and maintenance of instruments, the harmful effects of radiation, radiation protection, and recommended permissible radiation dosages. Lectures will be supplemented by laboratory work and practical exercises in calibration and application. Application should be made through the sponsoring agency and should be addressed to George W. Cox, M.D., State Health Officer, 410 East 5th Street, Austin, Texas. No tuition will be charged.

A Study of Salaries of Industrial Hygiene Personnel

A Report of the Temporary Committee on Survey of Salaries*

IN JUNE, 1950 a temporary committee was appointed by DR. ALLEN D. BRANDT, president of the AMERICAN INDUSTRIAL HYGIENE ASSOCIATION, to conduct a survey for the purpose of determining the salary status of industrial hygiene personnel. The need for such information for reviewing already established positions in industrial hygiene, as well as for the institution of new ones, is obvious. The committee prepared a brief questionnaire, and distributed it to the members of both the AMERICAN INDUSTRIAL HYGIENE ASSOCIATION and the AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS late in August, 1950. A total of 1,026 questionnaires were distributed, with 717 returned. Of those returned, 17 were not suitable for tabulation. The tabulation of the results was begun in November, 1950, so that the present report, therefore, covers the salary status of 700 personnel or approximately 70% of the total membership of these two organizations, between August and November, 1950. Any salary changes which have developed since the latter date are not included.

Because of the nature of the data, an arbitrary scheme was adopted for tabulation. This is shown in Fig. 1.

The tabulated results, according to years of experience in each of the professional background, employment, and professional activity classifications are shown in Table I. Median salary values for each of the professional background classifications are also shown. These medians were calculated graphically to the nearest $100. Obviously, in those cases involving small numbers of

*The results of the study were presented to the AMERICAN INDUSTRIAL HYGIENE ASSOCIATION Board of Directors at its April, 1951 meeting, and publication was authorized. WILLIAM E. MCCORMICK, a 1951 addition to the committee, prepared the report for publication, including the various median calculations.

SCHEME FOR CLASSIFYING THE TABULATED DATA

Question	Actual Answer	Committee Classification
Employer	Government, and government plus any other.	Government
	Industry, and industry plus any other.	Industry
	Insurance, and insurance plus any other.	Industry
	University, and university plus any other.	Other
Professional Background (major interest)	Chemical, and chemical plus any other.	Chemical
	Engineering, and engineering plus any other.	Engineering
	Medical, and medical plus any other.	Medical
	Nursing, and nursing plus any other.	Nursing
	Toxicological, and toxicological plus any other.	Toxicological
	None of above.	Other
Years of Experience	Experience in another profession.	Disregarded
	time devoted to one.	Type requiring
Professional Activity	Several types, no definite plurality of	plurality of time
	Several types, no definite plurality of time devoted to any one.	Type requiring most of time in the following: Administration Field Investigations Laboratory Other (teaching research).

Fig. 1.

personnel, the accuracy of the medians is questionable. They do, however, represent the best values available at this time.

In Table II are summarized, by type of employment for each of the professional backgrounds, the number reporting, the median salaries, and the median years of experience. The last values were calculated graphically to the nearest half year.

Table III shows the median salary values according to professional activity in each of the employment categories, without regard to years of experience.

The committee desires to thank the membership of both the AMERICAN INDUSTRIAL HYGIENE ASSOCIATION and the AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS for their cooperation in supplying the necessary information. It also desires to express appreciation to DR. HENRY F. SMYTH and DR. BRANDT for their guidance in the project, and to DR. SMYTH'S and DR. PETRIE'S clerical staffs for the tabulation and compilation of the results.

A.I.H.A. Committee on Survey of Salaries
LESTER M. PETRIE, M.D., Chairman
J. D. KELLEY, M.D.
JOHN W. LEMON
WILLIAM E. MCCORMICK
HUGH L. PARKER

TABLE I

Years of Experience	Professional Background	Employer	Annual Salary: < $3000				$3000-3599				$3600-4799				$4800-5999				$6000-7499				$7500-9999				$10,000-12,499				> $12,500				Median	Totals
			Admin.	Field	Lab.	Other	Admin.	Field	Lab.	Other	Admin.	Field	Lab.	Other	Admin.	Field	Lab.	Other	Admin.	Field	Lab.	Other	Admin.	Field	Lab.	Other	Admin.	Field	Lab.	Other	Admin.	Field	Lab.	Other		
4 or less	Chemical	Gov't.		1	5			1	9			7	6		1		2																			[illegible]
		Industry										2	2								1															5
		Other																																		
		Total		1	5			1	9			9	8		1		2				1														$3800	
	Engineering	Gov't.		5	3		2	20	5	2	4	28	3	1		2	1																			[illegible]
		Industry										1			2	2		1				1														7
		Other							1																											1
		Total		5	3		2	20	6	2	4	29	3	1	2	4	1	1				1													$3700	
	Medical	Gov't.													1					2		2		1												6
		Industry										1											1			1										3
		Other																																		
		Total										1			1					2		2	1	1		1									$7100	
	Nursing	Gov't.																																		
		Industry						1	1			2		1																						5
		Other																																		
		Total						1	1			2		1																					$3800	
	Others	Gov't.			1			2				1				1		1																		6
		Industry																																		
		Other																																		
		Total			1			2				1				1		1																	$3600	
	Toxicological	Gov't.						1																												1
		Industry																																		
		Other							1																											1
		Total						1	1																										< $3600	
Totals				6	9		2	25	17	2	4	42	11	2	4	5	3	2		2	1	3	1	1		1										[illegible]
5—9	Chemical	Gov't.			1							3	8		1	2			1				1													17
		Industry											1						3				2													6
		Other											4							1																5
		Total			1							3	13		1	2			4	1			3												$4700	
	Engineering	Gov't.		1				1			3	15	2	1	4	7	1			2		1														[illegible]
		Industry										1			1	1			3	1			2													9
		Other			1								1	1		1			1					1												6
		Total		1	1			1			3	16	3	2	5	9	1		4	3		1	2	1											$4800	
	Medical	Gov't.										1				1			3			1	2			1										9
		Industry																				1	4			1	1	1			1					9
		Other																	2				1			1										4
		Total										1				1			5			2	7			3	1	1			1				$8100	
	Nursing	Gov't.				1		1				1						2																		5
		Industry																2																		2
		Other																																		
		Total				1		1				1						4																	$4900	
	Others	Gov't.					1	7				1	1		1	1		1																		13
		Industry														1				1			1													3
		Other																											1							1
		Total					1	7				1	1		1	2		1		1			1						1						$3500	
	Toxicological	Gov't.					1						1		1	1	1																			5
		Industry															1						1													2
		Other															1				3															4
		Total					1						1		1	1	3				3		1												$5800	
Totals				1	2	1	2	9			3	22	18	2	8	15	4	5	13	5	3	3	14	1		3	1	1	1		1					

TABLE I — Continued

Experience	Professional Background	Employer	Annual Salary <$3000				$3000-3599				$3600-4799				$4800-5999				$6000-7499				$7500-9999				$10,000-12,499				>$12,500				Median	Totals
			Admin.	Field	Lab.	Other	Admin.	Field	Lab.	Other	Admin.	Field	Lab.	Other	Admin.	Field	Lab.	Other	Admin.	Field	Lab.	Other	Admin.	Field	Lab.	Other	Admin.	Field	Lab.	Other	Admin.	Field	Lab.	Other		
10 — 14	Chemical	Gov't.										3	4		3	4	2		4	1	2		2													25
		Industry										1					1		4				2		1											9
		Other																		1	1		1						1							4
		Total										4	4		3	4	3		8	2	3		5		1				1						$6100	38
	Engineering	Gov't.						1			4	6		1	4	9	4	2	5	4	1	1	3	1	1				1							48
		Industry										1			4	3			4	1		1	5		1											20
		Other													2						1	1														4
		Total						1			4	7		1	10	12	4	2	9	5	2	3	8	1	2				1						$5800	72
	Medical	Gov't.																	2	1			5	2		2	2									14
		Industry																					3				5			3	4	1		1		17
		Other													1				1				1			3	1							2		9
		Total													1				3	1			9	2		5	8			3	4	1		3	$9800	40
	Nursing	Gov't.				1	1		1	1	1	1																								6
		Industry																																		
		Other																																		
		Total				1	1		1	1	1	1																							$3500	6
	Others	Gov't.	1	1								2							1		1			1												7
		Industry																			1															1
		Other																																		
		Total	1	1								2							1		2			1											$4800	8
	Toxicological	Gov't.											1							1	1															3
		Industry																	2		1		2		2											7
		Other											1								1															2
		Total											2						2	1	3		2		2										$6800	12
Totals			1	1		1	1	1	1	1	5	14	6	1	14	16	7	2	23	9	10	3	24	4	5	5	8		2	3	4	1		3		176
15 — 19	Chemical	Gov't.											1		1		3			1	1		1		1											9
		Industry										1				4	1		2	1			1		2											12
		Other															1			1																2
		Total										1	1		1	4	5		2	3	1		2		3										$5800	23
	Engineering	Gov't.										1			3	2			5	1			1				1									14
		Industry										2					1			5			4		1	1	4		1	2	2					23
		Other																				2										1				3
		Total										3			3	2	1		5	6		2	5		1	1	5		1	2	2	1			$7300	40
	Medical	Gov't.									1				1			1	2				2													7
		Industry																	1				1			1	1				5					9
		Other													1											2										3
		Total									1				2			1	3				3			3	1				5				$8600	19
	Nursing	Gov't.		1				2		5	1	3		2				2																		16
		Industry																																		
		Other																																		
		Total		1				2		5	1	3		2				2																	$3600	16
	Others	Gov't.							1			1																								2
		Industry																									1									1
		Other																																		
		Total							1			1															1								$4200	3
	Toxicological	Gov't.															2		1		1				2				1							7
		Industry																															1			1
		Other																																		
		Total															2		1		1				2				1				1		$7500	8
Totals				1				2	1	5	2	8	1	2	6	6	8	3	11	9	2	2	10		6	4	7		2	2	7	1	1			109
20 or more	Chemical	Gov't.										1	2			1							3		1								1			9
		Industry															1						2		2		1				1					7
		Other															1																			1
		Total										1	2			1	2						5		3		1				1		1		$7200	17
	Engineering	Gov't.										1		2	2	2	1	2	4		1	1	5	1			1									23
		Industry										1			1			1	3	3			4	1	1		2				1			1		19
		Other																	1	1			1		2	1					1			1		8
		Total										2		2	3	2	1	3	8	4	1	1	10	2	3	1	3				2			2	$7300	50
	Medical	Gov't.													1								2	1			5									9
		Industry													1	1							3			1	1			2	2			4		15
		Other												1	1											1					1			4		8
		Total												1	3	1							5	1		2	6			2	3			8	$10,900	32
	Nursing	Gov't.				2						1		2	1							4														10
		Industry																																		
		Other																																		
		Total				2						1		2	1							4													$4800	10
	Others	Gov't.			1											1							1		1											4
		Industry					1																		1	1				1						4
		Other																1				1														2
		Total			1		1									1		1				1	1		2	1				1					$7500	10
	Toxicological	Gov't.									1		1				1		2				1				1						1			8
		Industry																			1								1		3					5
		Other							1																						1					2
		Total							1		1		1				1		2		1		1				1		1		4		1		$8400	15
Totals					1	2	1		1		1	4	3	5	7	5	4	4	10	4	2	6	22	3	8	4	11		1	3	10		2	10		134

TABLE II.

MEDIAN SALARIES AND MEDIAN YEARS OF EXPERIENCE OF THE VARIOUS PROFESSIONAL CLASSIFICATIONS

Professional Background	Number Reporting	Median Salary	Median Years of Experience
1. Chemical	143	5200.	10.5
a. Government	92	4700.	8.0
b. Industry	39	6800.	14.0
c. Other	12	6000.	10.5
2. Engineering	299	5500.	10.0
a. Government	199	4600.	7.0
b. Industry	78	7100.	15.0
c. Other	22	7200.	15.0
3. Medical	122	9200.	12.0
a. Government	45	7800.	12.0
b. Industry	53	10,300.	13.0
c. Other	24	8900.	13.5
4. Nursing	44	4000.	15.5
a. Government	42	4000.	16.0
b. Industry	2	$<$6000.	$<$9
c. Other	0	—	—
5. Others	44	4800.	9.0
a. Government	32	3800.	8.0
b. Industry	9	8000.	16.5
c. Other	3	6800.	$>$20.
6. Toxicological	48	6800.	13.5
a. Government	24	6000.	16.0
b. Industry	15	8700.	13.0
c. Other	9	6200.	8.5

TABLE III

MEDIAN SALARIES OF THE VARIOUS PROFESSIONAL ACTIVITIES ACCORDING TO EMPLOYMENT

Employer	Professional Activity and Median Salary							
	Administration		Field		Laboratory		Other	
	Number Reporting	Median Salary	Number Reporting	Median Salary	Number Reporting	Median Salary	Number Reporting	Median Salary
Government	115	6,700	178	4,300	94	4,400	46	5,800
Industry	106	8,900	39	5,700	26	7,700	27	10,200
Other	17	7,100	7	7,300	23	5,400	22	8,700
Total	238	7,500	224	4,500	143	4,900	95	6,700

BACK ISSUES AVAILABLE

Single copies of nearly all issues of the AIHA Quarterly, since its appearance in June, 1946, as a separate journal, may be obtained from the Executive Secretary.

The President's Page

The Contribution of the American Industrial Hygiene Association to the Progress of Industrial Hygiene

WHAT ARE *the essential factors which are necessary for the progress of industrial hygiene and how has the American Industrial Hygiene Association contributed toward this progress?*

First, advancement in industrial hygiene, just as in any other science, depends on the acquisition of knowledge through research, careful observation, and study. This is the particular contribution which our Association, through the work of its members, can make. Whereas other organizations in the field of industrial hygiene are concerned primarily with the administrative and the service aspects, the American Industrial Hygiene Association is largely concerned with the acquirement of scientific and technical knowledge. The many scientific and technical papers which are offered at the annual meetings testify to this interest. However, we must never be content with the knowledge we already have acquired. Only insofar as we continue to add to our fund of basic information and develop new ideas, will the field of industrial hygiene develop and our organization grow in value and strength.

Second, industrial hygiene is not a single science which requires a common background of training for persons working in this field; on the contrary, it represents a collective group of many sciences contributing jointly to a common goal. Thus, in order to acquire the basic information which is necessary for the progress of industrial hygiene, specialists in many disciplines must work in this field. Specialization is essential in the world today, but, as specialization develops, just so much more does each specialty become dependent on all other branches of science. Progress in industrial hygiene is dependent on the integrated application of the knowledge acquired by the specialists in all branches of science to the peculiar problems in this field. No major problem in industrial hygiene, for example the problem of a toxic hazard, can be solved without biological research workers to determine the toxic effects of the substances, chemists and physicists to study the chemical and physical properties of the material and to measure the concentration of the substances present, engineers to study the exposure and to develop control measures, and doctors to determine the effects of the substance on the physical condition of the workers. Similar coordinated activity of all these sciences is required in every other type of problem. Because of the increasing development of specialization in industrial hygiene, the American Industrial Hygiene Association is considering the possibility of placing more emphasis on the special groups within our organization, but, at the same time, we are convinced that no specialty can progress without the cooperation of all groups. Only when all of these specialists direct their efforts jointly toward the problems in this field can industrial hygiene advance. The American Industrial Hygiene Association is designed to bring together into one group all of the various specialties and to afford an opportunity for all of these groups to meet and work together.

Thus, although the American Industrial Hygiene Association is small in membership, it is a vital organization in the progress of industrial hygiene.

—ANNA M. BAETJER, SC.D.

American Industrial Hygiene Association

— Twelfth Annual Meeting —
Atlantic City, New Jersey

THE Twelfth Annual AMERICAN INDUSTRIAL HYGIENE ASSOCIATION Conference was held at Chalfonte-Haddon Hall, Atlantic City, New Jersey, April 23-26, with 252 members registering.

Much favorable comment was heard at the meetings regarding the excellence of the papers and the manner in which they were presented. Some improvement in the lantern slides was also noted.

At the annual banquet held at the Hotel Jefferson, 194 members were in attendance. At this affair, the Donald E. Cummings Memorial Lecture was ably presented by THEODORE HATCH who stressed the importance of cooperative effort by the several specialties in the field of industrial hygiene.

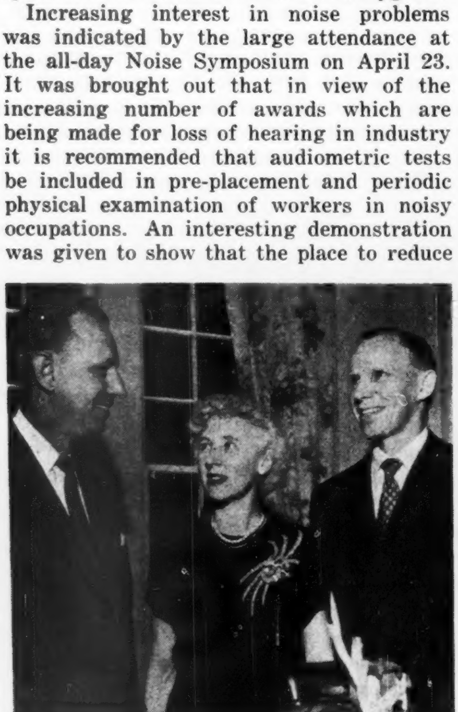
Increasing interest in noise problems was indicated by the large attendance at the all-day Noise Symposium on April 23. It was brought out that in view of the increasing number of awards which are being made for loss of hearing in industry it is recommended that audiometric tests be included in pre-placement and periodic physical examination of workers in noisy occupations. An interesting demonstration was given to show that the place to reduce noise is at the source. Noisy machinery is usually machinery that is worn or being subjected to appreciable wear. One speaker expressed the belief that noise which does not interfere with normal speech causes no injury.

At the annual business meeting held April 26, the following officers were elected for the 1951-52 term:

President, ANNA M. BAETJER, SC.D., The Johns Hopkins School of Hygiene and Public Health; President-Elect, WILLIAM R. BRADLEY, American Cyanamid Company; Secretary, FREDERICK S. MALLETTE, American Steel and Wire Company; Treasurer, C. H. MAHAFFEY, Mine Safety Appliances Company; and Executive Secretary, HENRY F. SMYTH, JR., PH.D.

Newly-elected members of the Board of Directors are JAMES W. HAMMOND, Humble Oil and Refining Company; W. G. HAZARD, Owens-Illinois Glass Company; J. C. RADCLIFFE, Ford Motor Company; and JOSEPH F. TREON, PH.D., Kettering Laboratory.

The next annual meeting of the American Industrial Hygiene Association will be held at the Netherlands Plaza Hotel in Cincinnati, Ohio, April 22-24, 1952.



Left, retiring President, Allen D. Brandt; newly-elected President, Anna M. Baetjer; and President-Elect, William R. Bradley. Right, Theodore F. Hatch receiving the 1951 Cummings Memorial Award from President Brandt.

American Industrial Hygiene Association
—News of Local Sections—

Metropolitan New York Section

On April 5, 1951 the section met jointly with the Greater New York Safety Convention and Exposition. The following sessions were held:

INDUSTRIAL HEALTH-ENGINEERING PHASES:

A. Safety Precautions in Handling Plating Wastes—Henry Harrison, Oakite Products, Inc., New York.

B. A Safety Engineer Looks at Industrial Hygiene—H. A. Cozzens, Jr., New York University.

C. Following Toxic Products into Industrial Use and Handling—W. R. Bradley, J. B. Gisclard, and J. H. Rook, American Cyanamid Company.

Chairman: William T. Ingram.

INDUSTRIAL HEALTH-MEDICAL AND CHEMICAL PHASES:

A. Current Methods of Determining Safety in the Application of New Chemicals—T. W. Nale, M.D., Union Carbide & Carbon Corporation.

B. Maximum Allowable Concentrations—Manfred Bowditch, Lead Industries Association.

C. Emotional Factors in Safety—Louis G. Giberson, M.D., Metropolitan Life Insurance Company.

Upper New York Section

This section had its first meeting on February 20, 1951, in Albany. The newly elected officers are as follows: President—William B. Deichmann, Ph.D., Union University; Vice President—Arthur J. Vorwald, M.D., Saranac Laboratory; Secretary—John J. Ferry, General Electric Company; and Treasurer—Edward C. J. Urban, Saranac Laboratory.

The Upper New York Section of the AIHA was organized only recently. Its purpose is to provide a common medium for those who are interested in research and in the medical, engineering and preventive phases of industrial hygiene for the protection and preservation of the health of workers in industry. An important function of the Section will be to hold frequent meetings, arrange for the publication of pertinent studies and aid in the interchange and dissemination of information.

Ohio Valley Section

On Aprl 18, 1951, the Frigidaire Division of General Motors Corporation was host to 86 members and guests of this section. The program consisted of a tour through the Frigidaire Plant and a model demonstration of radiant heat exposures by W. G. Hazard of Owens Illinois Glass Company.

Greater St. Louis Section

The Industrial Hygiene Association of Greater St. Louis held its annual meeting May 3, 1951, with approximately 65 in attendance, including 25 from the Nurses Club of St. Louis. The speaker was Dr. Arthur J. Vorwald of The Saranac Laboratory, who spoke on the effects of dust on the lungs.

In addition, the election of officers for the ensuing year was held. The following is the result of the election: Chairman—Dr. R. A. Sutter; Chairman-Elect—L. F. Garber; and Secretary-Treasurer—Jerome E. Molos. Executive committee members elected for two year terms are John Brennan, M.D., Lydia V. Dunne, R.N. and Art Truelson. Executive committee members elected for one year terms are Beryl M. Ward, R.N., K. J. Caplan and B. R. Brick.

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AIHA QUARTERLY

EDITORIAL

Catalytic Incineration—A New Tool for Air Pollution Control

AMONG the air pollution problems confronting chemical and certain other industries, many are caused by a variety of hydrocarbon vapors which are waste products of processes or operations. Many of these vapors cause nuisances, while others may be the source of fire and health hazards or of damage to crops and vegetation. Objectional odors frequently add to industry's problems of air pollution control.

The common methods of control of hydrocarbon vapors are scrubbing, charcoal absorption and combustion processes. The combustion method employing gas or oil as a fuel for hydrocarbon oxidation has the disadvantage of high maintenance cost due to the 1100°F temperatures required for complete oxidation. Since the cost of fuel adds to the overall cost picture, attempts may be made to institute economies by reducing operating temperatures. A reduction of these temperatures has the effect of reducing oxidation efficiencies.

The Catalytic Combustion Corporation, Detroit, Michigan, has developed equipment which employs the use of a catalyst for burning hydrocarbon vapors at temperatures considerably below those required in flame incinerators. It is reported that the equipment can be operated at high oxidation efficiency and where the hydrocarbon content of the exhaust gas is high, profits can be realized by utilizing the heat generated.

The equipment operates on the principle of passing the exhaust gas containing hydrocarbon vapor through a blower and catalytic element containing platinum at approximately 500°F. The hydrocarbon oxidation takes place without flame on the surface of the catalytic element, but a 500°F starting temperature usually is required. The combustion, of course, causes a sharp rise in temperature at the element and discharge temperatures may be as high as 1200°F depending upon the vapor content of the incoming gas. Some hydrocarbon vapors may be completely burned with an entry temperature as low as 350°F, especially if hydrocarbon content is high.

The catalytic element offers minimum resistance to gas flow, with the pressure drop through the unit reported to be less than 0.25 inches of water. The catalytic element recommended for gas flows of 1360 cfm is 19 x 24 x 2.5 inches thick. The element area is proportionally increased or reduced for other specified air flows. In small applications, the cost of the element and housing varies from $1.25 to $1.50 per cfm of gas velocity. For larger installations the cost per cubic foot is reduced by as much as 50% in some cases.

The applicability of catalytic combustion is limited to exhaust gases substantially free of non-flammable particulate matter. Particles larger than five microns will collect on the catalytic element causing clogging and rapid failure. However, if these contaminants can be removed by other methods prior to reaching the catalytic element, the equipment will operate successfully. Mercury, zinc and certain other metals will quickly "poison" the catalyst and should be avoided.

The results of engineering data regarding efficiency of catalytic combustion equipment under actual operating conditions would be of special interest to industry and to persons interested in air pollution control. Additional information is available from the manufacturers of this equipment.

—*Editor*

THE AIHA in cooperation with the American Society of Safety Engineers will sponsor a half-day session at the National Safety Congress in Chicago this Fall. Another half-day session will be held in Philadelphia during the Christmas meeting of the American Association for the Advancement of Science.